PHYSICAL PERFORMANCE, BODY COMPOSITION AND METABOLIC SYNDROME IN MILITARY PERSONNEL FROM THE BRAZILIAN ARMY

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DESEMPENHO FÍSICO, COMPOSIÇÃO CORPORAL E SÍNDROME METABÓLICA EM MILITARES BRASILEIROS

DESEMPEÑO FÍSICO, COMPOSICIÓN CORPORAL Y SÍNDROME METABÓLICO EN MILITARES BRASILEÑOS

Samir Ezequiel da Rosa[1]
(Physical Educator)
Marco Antônio Lippert[1]
(Physical Educator)
Runer Augusto Marson[1]
(Physical Educator)
Marcos de Sá Rego Fortes[1]
(Physical Educator)
Laércio Camilo Rodrigues[2]
(Physical Educator)
José Fernandes Filho[3]
(Physical Educator)

1. Instituto de Pesquisa da Capacitação Física do Exército – IPCFEx, Rio de Janeiro, RJ, Brazil.
2. Escola de Educação Física do Exército – EsEFEx, Rio de Janeiro, RJ, Brazil.
3. Universidade Federal do Rio de Janeiro –UFRJ, Rio de Janeiro, RJ, Brazil.

Correspondence:
Samir Ezequiel da Rosa. Instituto de Pesquisa da Capacitação Física do Exército – IPCFEx. Av. João Luís Alves, s/n, Urca, Rio de Janeiro, RJ, Brazil. 22291-090.
samirdarosa@hotmail.com

ABSTRACT

Introduction: The Brazilian Army (BA) considers Military Physical Training (MPT) essential for the development of physical conditioning and general health, including prevention of chronic noncommunicable diseases (CNCDs), including metabolic syndrome (MS) risk factors. The evaluation of body composition using dual-emission x-ray absorptiometry (DXA) quantifies the visceral fat responsible for several types of disease. Objective: To verify the behavior among the body composition, anthropometric, hemodynamic and biochemical variables by means of the physical performance of military personnel with MS (W/MS) and without MS (NO/MS). Methods: The sample consisted of 41 (38.9 ± 2.3 years, 177.8 ± 6.4 cm, 91.5 ± 11.9 kg) military personnel, with 28 individuals diagnosed as W/MS and 13 individuals as NO/MS. Data collection was divided into three days. An anthropometric assessment was performed on the first day. On the second day, the subjects underwent biochemical tests of MS markers, blood pressure (BP) checks, and DXA examinations. On the third day, a physical assessment was applied according to the requirements of the BA (12-minute run, pushups and pullups). Results: There was a significant difference between W/MS and NO/MS subjects in the variables of HDL-C, Diastolic BP, Systolic BP and Waist Circumference. None of the physical variables presented a significant difference. There was also a significant difference between groups for all body composition and anthropometric variables. Conclusion: NO/MS subjects have better mean body composition, BP and anthropometric values than W/MS subjects, which may indicate that they are at less risk of CNCDs. The fact that the military subject is or is not a carrier of MS did not influence the performance of the tests applied. ***Level of Evidence I; Diagnostic studies - Investigation of a diagnostic test.***

Keyword: Training; Military personnel; Metabolic Syndrome.

RESUMO

Introdução: O Exército Brasileiro (EB) considera o Treinamento Físico Militar (TFM) essencial para desenvolver o condicionamento físico e a saúde geral, inclusive a prevenção de doenças crônicas não transmissíveis (DCNT), considerando os fatores de risco de síndrome metabólica (SM). A avaliação da composição corporal por meio do aparelho de absorciometria por dupla emissão de raios-X (DXA) quantifica a gordura visceral responsável por vários tipos de doenças. Objetivo: Verificar o comportamento entre as variáveis composição corporal, antropométricas, hemodinâmicas e bioquímicas por meio do desempenho físico de militares com SM (C/SM) e sem SM (S/SM). Métodos: A amostra foi composta por 41 militares (38,9 ± 2,3 anos, 177,8± 6,4 cm, 91,5 ± 11,9 kg), sendo 28 indivíduos diagnosticados C/SM e 13 S/SM. A coleta de dados foi dividida em três dias. No primeiro dia foi realizada uma avaliação antropométrica. No segundo dia, os indivíduos foram submetidos aos exames bioquímicos dos marcadores de SM, medida da pressão arterial (PA) e exames deDXA. No terceiro dia, realizou-se uma avaliação física conforme as exigências do EB (corrida de 12 minutos, flexão de braço sobre o solo, flexão de braço na barra fixa). Resultados: Constatou-se diferença significativa entre os militares C/SM e S/SM nas variáveis HDL-C, PA diastólica, PA sistólica e circunferência da cintura. Nenhuma variável física apresentou diferença significativa. Verificou-se também diferença significativa entre os grupos para todas as variáveis de composição corporal e antropométricas. Conclusão: Os militares S/SM têm valores médios de composição corporal, PA e antropométricos melhores que os C/SM, o que pode indicar que têm menor risco de DCNT. O fato de o militar ter ou não SM não influenciou a performance dos testes aplicados. ***Nível de Evidência I; Tipo de Estudo: Estudos diagnósticos–Investigação de um exame para diagnóstico.***

Descritores: *Treinamento; Militar; Síndrome metabólica.*

RESUMEN

Introducción: El Ejército Brasileño (EB) considera el Entrenamiento Físico Militar (EFM) esencial para desarrollar el condicionamiento físico y la salud general, inclusive la prevención de enfermedades crónicas no transmisibles (ECNT), considerando los factores de riesgo del síndrome metabólico (SM). La evaluación de la composición corporal por medio del aparato de absorciometría por doble emisión de rayos X (DXA) cuantifica la grasa visceral responsable de varios tipos de enfermedades. Objetivo: Verificar el comportamiento entre las variables composición corporal, antropométricas, hemodinámicas y bioquímicas por medio del desempeño físico de militares con SM (C/SM) y sin SM

(S/SM). Métodos: La muestra fue compuesta por 41 militares (38,9 ± 2,3 años, 177,8 ± 6,4 cm, 91,5 ± 11,9 kg) siendo 28 individuos diagnosticados C/SM y 13 S/SM. La colecta de datos fue dividida en tres días. En el primer día se realizó una evaluación antropométrica. En el segundo día los individuos fueron sometidos a los exámenes bioquímicos de los marcadores de SM, medición de la presión arterial (PA) y exámenes de DXA. En el tercer día se aplicó una evaluación física conforme a las exigencias del EB (carrera de 12 minutos, flexión de brazo sobre el suelo y flexión de brazo en la barra fija). Resultados: Se constató diferencia significativa entre los militares C/SM y S/SM en las variables de HDL-C, PA diastólica, PA sistólica y circunferencia de cintura. Ninguna variable física presentó diferencia significativa. Se verificó también diferencia significativa entre los grupos para todas las variables de composición corporal y antropométricas. Conclusión: Los militares S/SM poseen valores promedio de composición corporal, de PA y antropométricos mejores que los C/SM, lo que puede indicar que tienen menor riesgo de ECNT. El hecho de que el militar tenga o no SM no influenció en el desempeño de las pruebas aplicadas. ***Nivel de evidencia I; Tipo de Estudio: Estudios diagnósticos – Investigación de un examen para diagnóstico.***

Descriptores: *Entrenamiento; Personal militar; Síndrome metabólico.*

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INTRODUCTION

The Brazilian Army (BA) considers the Military Physical Training (MPT) of fundamental importance to develop the physical conditioning and maintain a general health necessary for the operability of the troop. The physical evaluation test (PET) allows us to verify how the military is prepared for combat[1,2].

TFM assists in the prevention of chronic noncommunicable diseases (CNCD), including Metabolic Syndrome (MS). This is relevant because studies show that the prevalence of this syndrome has been reported in both the military and civilian environments, even in the military population, mainly aged ≥ 35 years, despite having a higher physical state than the general population[3,4].

The evaluation of the body composition is of paramount importance in order to be able to identify the components of the human body in a quantitative way and also to allow the total body mass to be shown by the percentages of fat and lean mass[5]. At the beginning of the 20th century, the analysis of body composition was performed through cadaver dissection (in vitro), which until now has been considered the only direct way to measure body components [5]. It is worth noting that, in addition to this direct method, there are still indirect ones such as plestimography, hydrostatic weighing and dual-emission x-ray densitometry (DXA) and double-indirect bioimpedance and skinfolds[6]. The X-ray absorptiometry device (DXA) produces accurate estimates of regional and global body composition offering advantages over more traditional means of measurement[6].

Risk factors for CNCD are more associated with the location of adipocytes, that is, the distribution of body fat is a relevant factor in the clinical evaluation. In this sense, according to its location, the adipocyte presents different metabolic characteristics, and intra-abdominal adiposity is the one with the greatest negative impact on health[3,4,6].

The visceral adipocyte is an active hormonal component of total body fat, possessing unique biochemical characteristics that influence various normal and pathological processes in the human body. This phenotype of body composition is associated with pathological disorders such as MS, cardiovascular diseases and various types of cancer. The quantitative evaluation of visceral obesity is important to evaluate the potential risk of developing these pathologies, in addition to providing a precise prognosis[7].

The inverse relationship between physical performance and body fat is fundamental for the development of physical, operational and quality of life training of the military[8]. The negative impact of the presence of the components of the metabolic syndrome (MS) in health and general quality of life of the population is quite significant [9]. Militaries with MS have worse health indicators, when compared to military ones as risk factors of the syndrome[3]. However, when comparing the results of physical evaluation tests (TAF), this difference does not appear to exist[3].

The aim of this study was to verify the behavior among the variables of body composition, anthropometric, hemodynamic and biochemical by means of the physical performance of military personnel with MS (W/MS) and without SM (NO/MS).

MATERIALS AND METHODS

The sample consisted of 41 militaries (38.9 ± 2.3 years, 177.8 ± 6.4 cm, 91.5 ± 11.9 kg) of the Brazilian Army, students of the School of Command and Staff (ECEME), of which 28 (38.5 ± 1.9 years) were diagnosed with MS and 13 (39.3 ± 2.5 years) without MS. Included in the group were the active service military of the BA and attending the first year of the ECEME. Military personnel who were unfit for health examinations and/or who had not performed all the evaluations and examinations proposed by the team of researchers were excluded from the group. This cross-sectional study was registered in the National System of Research Ethics (SISNEP), submitted by the Ethics Board of the Naval Hospital Marcílio Dias, nº 1,551,242.

Data collection was divided into three days. On the first day, an anthropometric evaluation was performed[10], the total body mass (TBM) being determined with m one being maintained in the orthostatic position, using only swimwear, on the weight balance P150M, with a maximum load of 200 kg and a 0.1% increase[10]. The stature was measured with a metallic stadiometer, brand Sanny. The evaluated patients were standing erect, where the spleens extended and attached to the trunk, feet joined and maintaining the contact with the stadiometer by the heel, with the head adjusted to the Frankfurt plane (measurements were performed with the evaluated in respiratory apnea waist circumference (WC) was measured with a 2M anthropometric scale, model Sanny medical, Starret, model: SN 4010. The measurement of WC was performed as assessed in orthostatic position and the relaxed abdomen at the point of least circumference line of the last rib put with the tape in a horizontal plane[10].

On the second day the biochemical tests of the markers of MS (TG, HDL-C, Glic) were performed. The collections were carried out in the laboratory of clinical analyzes of the IPCFEx by the Pharmaceutical - Biochemistry Norma Claudia de Macedo Souza Santos (CFR/RJ 81869) and his team, strictly respecting the collection recommendations of the Brazilian Society of Clinical Pathology/Medicina Medicina de 2010[11] and the Resolution of the Collegiate Board -RDC No. 306/2004 - ANVISA for the management and disposal of samples.[12]. Then a hemodynamic evaluation (SBP, DBP) was conducted according to what is prescribed by the Brazilian Arterial Hypertension Guidelines for Use of Ambulatory Blood

Pressure Monitoring, published by the Brazilian Society of Cardiology 2016[13]. Finally, a body composition assessment using the DXA scanner (Lunar iDXA, GE Healthcare) following the official positions 2008 of the Brazilian Society of Clinical Densitometry (SBDens)[14] determined the values of TBM, FAT MASS, % Total FAT, FMI and VF.

On the third and final day, a physical evaluation was applied according to the requirements of EB (12 minutes run, push up, pull up and abdominal supra)[2]. For the diagnosis of metabolic syndrome, the parameters of the Joint Scientific Statement (JSS)[15] were used. All participants, after receiving clarification on the procedures and risks to which they would be submitted, had the Free and Informed Consent Form signed by their legal representatives. The study was approved by the Ethics and Research Committee of Universidade Salgado de Oliveira-UNIVERSO, Niterói, RJ, Brazil and followed the established standards of the National Ethics and Research Commission (CONEP), CAAE: 55948016.1.0000.5289.

Statistical treatment

The Shapiro-Wilk test confirmed the normal distribution of the data. Data are presented as mean and standard deviation. The Student t test for independent samples was used to compare the anthropometric, hemodynamic, biochemical and physical variables. It was adopted $p < 0.05$ as statistical significance. All analyzes were performed in Statistica 7.0 software.

RESULTS

Table 1 shows the mean results of the anthropometric variables evaluated in the DXA and the *t test* among the groups diagnosed with MS and without MS. It can be observed that there was a significant difference between the groups for all variables of body composition and anthropometrics surveyed.

Table 2 presents the mean results of the physical, hemodynamic, biochemical and anthropometric variables evaluated, as well as the t test among the group diagnosed with MS with or without MS. The significant difference was only found in the variables HDL-C, DBP, SBP and WC. No physical variables presented a significant difference.

Table 1. Results of the mean difference test of the body composition variables, anthropometric DXA among military personnel NO/SM e W/SM.

	NO/SM	W/SM	t test	
Variables	**Mean**	**Mean**	**t**	**p**
TBM	89.90	94.70	-2.59	0.0133*
FM	22.20	29.40	-3.05	0.0040*
%FM	25.80	30.80	-3.01	0.0044*
FMI	7.06	9.28	-3.05	0.0040*
GV(g)	871.38	1520.0	-3.13	0.0333*
GV(cm^3)	923.77	1611.0	-3.12	0.0033*

NO/SM: no metabolic syndrome, W/SM: no metabolic syndrome, TBM: body mass, FM: fat mass, %FM: % fat mass, FMI: fat mass index, VF: visceral fat, * significance for p≤0.005.

Table 2. Results of the test of difference of averages of the physical, hemodynamic, biochemical and anthropometric variables among military personnel NO/SM e W/SM.

	NO/SM	W/SM	t test	
Variables	**Mean**	**Mean**	**t**	**p**
12 min Run	2767.0	2633.0	1.38	0.1778
Pull Up (rep)	3.33	3.80	-0.29	0.7738
VO_2Max	50.56	47.6	1.38	0.1778
Glic (mg/dL)	83.15	86.40	-0.62	0.5372
TG (mg/dL)	97.20	103.60	-0.43	0.6669
HDL-C(mg/dL)	46.46	69.21	3.22	0.0025*
SBP (mmHg)	120.80	134.70	-3.73	0.0006*
DBP (mmHg)	75.40	92.50	-3.74	0.0005*
WC	94.40	99.60	-2.13	0.0388*

NO/SM: No Metabolic Syndrome, W/SM: without Metabolic Syndrome, rep: repetitions, Glic: glucose, TG: triglycerides, HDL-C: low density lipoprotein, SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: Waist circumference, * significance for p≤0.005.

DISCUSION

The present study verified the difference between body composition, anthropometric, hemodynamic, biochemical and physical variables of military diagnosed with SM and without SM. The main findings showed that the group of syndromics is more exposed to risk factors for CNCD, than the non-syndromic group. A recent systematic review of the civilian population showed that syndromic people have a worse quality of life when compared to non-syndromic, but data on the military population are scarce[16]. Analyzing the body composition and anthropometric variables of the DXA, it was observed that the NO/SM military group had better health parameters when compared to the W/SM group (Table 1). Studies involving DXA show a significant positive correlation between the amount of VF, % FM and the risk factors of MS in groups of syndromic individuals [17,18]. Rothney et al measured GV by DXA in 541 men and 398 women and had a high association with cardiometabolic risk factors in individuals diagnosed with MS[19]. In 2009, a study by Kelly et al.[20] developed FMI to create a classification of obesity based on the actual amount of body fat by DXA. Not many studies were found on this health marker, but some findings found a significant positive correlation with risk factors for MS, corroborating the findings of this study[21,22].

There is a consensus in the scientific literature that MS is directly related to dyslipidemia, hyperglycemia, central obesity by WC and hypertension, which are also factors of CNCD[23]. One of the few studies involving the military population of Brazil analyzed 1,581 active military personnel of the navy showed that the most prevalent risk factor in the population was the low level of HDL cholesterol, which was present in 43% of the individuals. Even in this same finding, high blood pressure, hypertriglyceridemia and fasting glycemia greater than or equal to 100mg / dL were the most prevalent risk factors, and MS was diagnosed in 17.4%. [24] Rosa et al postulated, in a study involving 262 male BA military men aged 19 to 49 years old, selected for the UN peacekeeping mission in Haiti, that there is an inverse relationship between HDL-C and CC, evidencing instruments indirect predictors of CNCD.[8] A survey by the French Army analyzed 2045 military men aged 20 to 58 partially concluded that, even doing military physical training, 9% of military personnel had at least 3 risk factors for MS, and the frequency of hypertension was 51%, hyperglycemia 5%, altered triglycerides of 17%.[25] Gámez et al carried out a prospective cross-sectional study with 51 W/SM and 43 NO/SM subjects and found that the variables HLD-C, Glic, TG, SBP, DBP, and WC showed significant differences between the means of the groups.[26] The syndromic military with higher WC and high DBP/SBP presented a greater risk factor for endothelial function and thus possible future atherosclerotic damage.[26] Increased CVD is a risk factor for CNCD and MS, as it relates to the accumulation of adipose tissue in the visceral region.[9,27] In this study military men from the W/SM army presented the WC significantly larger than the NO/SM group, thus placing them on alert for CNCD.

The scientific literature associates the well-conditioned military with better biochemical indicators that represent general health[28.] However, in the present study we did not find a significant difference in the variables between the military men with mean age 38.5 years diagnosed with MS and without MS. In this study, Rosa et al.[29] observed that male military men with a mean age of 38.9 years, diagnosed with MS, after 27 weeks of planned MPT in a 3 to 5 weekly session (Monday to Friday 2 times of 45 minutes per day, normally distributed in aerobic and neuromuscular sessions, within the intensity recommended by the MPT manual (70 to 90% HRmax) did not present significant differences in the physical variables (12 minute run, arm in the floor, arm flexion in the bar and supra abdominal). One important observation is what can be called the "ceiling effect". This refers to the fact that physical fitness tests, to which each military man is subjected, are based on performance

concepts (excellent, very good, good, fair, and insufficient). This in a way may have inhibited each grader from giving his or her maximum during the 12-minute run and the repetitions of arm flexion, supra abdominal, and flexion in the bar, could already have reached the minimum index within the range of values that the desired concept.

Finally, in a recent survey, the Cooper Center Longitudinal Study presented results from a cross-sectional mapping study of 1979-2013 designed to examine the association between US Army active duty military personnel and MS risk factors.[30] Evidence indicates a null association between active military service and the prevalence of metabolic syndrome, a low prevalence of high levels of TG and low levels of HDL-C, but showed a high prevalence of SBP.

CONCLUSION

This analysis concluded that military personnel, not diagnosed with MS, have better mean body composition, blood pressure and anthropometric values than syndromics, which may indicate that they are less at risk for CNCD. The fact that the military was a carrier or not of the SM did not influence the performance of the tests applied. So health prevention strategies will need to reach the Brazilian military population in general, in order to reinforce the factors of protection to the CNCD, the SM and still be able to reduce the costs of health, improving the quality of life and productivity of the military.

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