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Strength indicators and usual physical activity among university administrative employees

Indicadores de força e prática habitual de atividades físicas em agentes universitários

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ABSTRACT | Background: Sedentary behavior is a risk factor for several diseases, while physically active lifestyles and physical fitness contribute to the promotion and maintenance of health. **Objective**: To establish the level of physical activity of university administrative employees and investigate its relationship with muscle strength indicators and morphological characteristics. **Methods**: The sample comprised 44 university administrative employees. Data on body mass (BM) and height were collected to calculate the body mass index. The participants' level of physical activity was established based on the International Physical Activity Questionnaire (IPAQ). The participants were subjected to four muscle strength tests: right hand grip (RHG), left hand grip (LHG), lumbar traction (LT) and lower limb traction (LLT). Relative muscle strength (%MS) was calculated dividing absolute muscle strength (AMS=RHG+LHG+LT+LLT) by BM. **Results**: The insufficiently active participants exhibited significant higher BM, lower LT, LLT, AMS and %MS, and spent more time in sedentary activities on weekends. **Conclusion**: Physical inactivity was associated with poorer muscle strength indicators and higher BM among university administrative employees, pointing to harms inherent to sedentary behavior.

Keywords | muscle strength; exercise; sedentary lifestyle; obesity.

RESUMO | Introdução: O sedentarismo é um fator de risco para o desenvolvimento diversas doenças, enquanto o estilo de vida fisicamente ativo e a aptidão física podem atuar na promoção e na manutenção da saúde. **Objetivo**: Verificar o nível de atividade física e compará-lo com indicadores de força muscular e estrutura morfológica em agentes universitários. **Método**: Participaram do estudo 44 agentes universitários, dos quais foram coletados valores da massa corporal (MC) e de estatura, para posterior cálculo do Índice de Massa Corporal. A análise do nível de atividade física foi realizada pelo Questionário Internacional de Atividade Física (IPAQ). Em seguida, os agentes universitários foram submetidos a quatro testes de força: preensão manual direita (PMD) e esquerda (PME), tração lombar (TL) e tração de membros inferiores (TMI). A força muscular relativa (%FM) foi estimada pela divisão da força muscular absoluta (FMA=PMD+PME+TL+TMI) pela MC. **Resultados**: O grupo insuficientemente ativo apresentou significativamente maior MC, maior tempo de comportamento sedentário nos fins de semana e menores indicadores de TL, TMI, FMA e %FM comparado aos fisicamente ativos. **Conclusão**: A inatividade física foi associada a menores indicadores de força muscular e maior MC em agentes universitários, sugerindo riscos para a saúde inerentes ao comportamento sedentário.

Palavras-chave | força muscular; atividade física; sedentarismo; obesidade.

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INTRODUCTION

Health problems among workers have been discussed for several decades. In the 19th and 20th centuries, such problems included, *e.g.*, heavy metal poisoning and infection. In the present time, the emphasis falls on repeated strain injury (RSI), musculoskeletal disorders and chronic degenerative diseases[1,2].

A considerable part of the Brazilian population spend most of their time at the job, often sitting for long periods of time and in ergonomically inadequate postures. Static and repetitive postures contribute to muscle atrophy and consequent loss of muscle strength[3], resulting in significantly higher risk for modern diseases (RSI, heart failure, diabetes and musculoskeletal disorders).

Leisure-time sedentary behavior is defined as neglect to perform physical activity in the leisure time, understanding physical activity as any bodily movement produced by skeletal muscles that results in energy expenditure[4]. According to the World Health Organization (WHO), physical activity might prevent the occurrence of 22% of the cases of heart disease, 10 to 16% of type 2 diabetes and several types of cancer[5].

Some studies showed that several chronic diseases are caused by physical inactivity. Noncommunicable diseases (NCD) — involving the circulatory system, neoplasms and diabetes, among others — account for a large proportion of diseases in Brazil and about 50% of deaths[6]. This is the result of inadequate diet, smoking and physical inactivity, among other factors.

One of the main factors associated with NCD, physical inactivity currently is the fourth leading cause of death and morbidity, surpassing obesity. Physical activity is one strategy for prevention, control and rehabilitation of NCD[2].

The aim of the present study was to investigate the level of physical activity of university administrative employees and test its relationship with indicators of muscle strength and morphological structure.

METHODS

SAMPLE

We collected data from 44 administrative employees (23 men and 21 women) of Universidade Estadual do Centro-Oeste (UNICENTRO), Guarapuava, Parana, Brazil, who voluntarily agreed to participate. The study was approved by the committee of ethics in research involving human beings of UNICENTRO, ruling no. 857,658.

Eligible subjects who agreed to participate in the study were interviewed in the workplace. After receiving information on the study aims, the participants signed an informed consent form.

PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR

The participants' level of physical activity was investigated by means of the short version of International Physical Activity Questionnaire (IPAQ) validated and tested in Brazil by Matsudo et al.[7] IPAQ physical activity categories (inactive, minimally active, active, very active) were clustered as insufficiently active (inactive and minimally active) and active (active and very active). Sedentary behavior time (SBT) was defined as the time, in minutes, respondents remained sitting in a workday and weekend day.

ANTHROPOMETRY

Body mass (BM) and height were self-reported, considering the strong concordance between measured and self-reported data. The participants simply informed the corresponding values, this method having been previously validated[8,9]. This information was used to calculate the body mass index (BMI; kg/m^2).

MUSCLE STRENGTH

Muscle strength (MS) indicators were investigated using hand grip (100 kgf) and lower limb (200 kgf) Crown® dynamometers. The participants were subjected to right (RHG) and left (LHG) hand grip, lumbar traction (LT) and lower limb traction (LLT) testing following Guedes' protocol[10]. The participants were given individual orientation on the measurement procedures and then performed two attempts immediately before actual testing to become familiar with the equipment.

Six-minute intervals were granted between tests and ninety-second intervals for recovery between attempts. Each test involved two attempts at maximum contraction and the best result was selected for analysis of MS (kgf). Absolute muscle strength (AMS) was calculated adding

the results on all tests (AMS=RHG+LHG+LT+LLT). Relative muscle strength (%MS) was calculated dividing AMS by BM (%MS=AMS/BM).

On RHG and LHG, the participants were requested to stand and hold the dynamometer with the arm extended along the body. The handhold was individually adjusted in a way that only the four last distal phalanges exerted strength on the traction bar. The participants were then requested to perform a maximum contraction.

LT was performed with the trunk in semiflexion and the arms and legs extended. The participants held the device bar and upon request performed a maximum contraction using the lumbar muscles.

LLT was performed with the trunk flexed, legs in semiflexion and the arms extended. The participants held the device and upon request performed a contraction without bending the lumbar muscles, but involving only the lower limb, hamstring and gluteus maximus muscles.

STATISTICAL ANALYSIS

To characterize the sample the participants were divided per sex and the variables of interest (age and SBT) were compared using the Mann-Whitney U test. According to their level of physical activity the participants were divided in two groups, insufficiently active (n=14) and active (n=30). The data were subjected to descriptive statistics and expressed as mean and standard deviation. Intergroup comparisons were performed with MANOVA adjusted for possible effects of sex as covariable and physical activity level. All the analyses were performed using software SPSS version 21; the significance level was set to $p<0.05$.

RESULTS

The sample characterization is described in Table 1. Sedentary behavior time was defined as the number of minutes spent sitting in one workday and one weekend day. Given the differences in BM, height and MS inherent to both sexes, we did not consider these characteristics. Men and women did not differ in age (p=0.851) or in the time spent in sedentary activities in workdays (p=0.211) or weekends (p=0.571).

Table 2 describes the results of the comparison of physical activity level, age, morphological characteristics (BM, height and BMI), MS strength indicators and time spent in physical activity in one workday and one weekend day. BM and BMI were significantly higher (13% and 10%, respectively) among the insufficiently active participants. Except for RHG and LHG, the MS indicators (LT, LLT, AMS and %MS) were significantly higher among the participants categorized as physically active.

The time spent in sedentary activities on weekends was longer (60%) for the insufficiently active participants. While the results for workdays were favorable to the insufficiently active participants, no difference was found between the groups.

Table 1. Sample characterization, Guarapuava, Parana, Brazil, 2015 (n=44).

Variables	Males (n=23)	Females (n=21)	Total sample (n=44)
Age (years)	36.9±10.7	38.0±12.7	37.4±11.6
Body mass (kg)	88.6±18.5	68.4±10.8	78.9±18.2
Height (m)	1.80±0.1	1.60±0.1	1.72±0.1
Body mass index (kg/m²)	27.2±4.3	25.7±4.3	26.5±4.3
Right hand grip (kgf)	49.7±10.0	28.6±5.6	39.6±13.4
Left hand grip (kgf)	49.2±14.6	26.4±6.1	38.3±16.1
Lumbar traction (kgf)	100.6±34.2	54.2±19.9	78.4±36.5
Lower limb traction (kgf)	113.2±43.3	54.7±16.8	85.3±44.3
Absolute muscle strength (kgf)	312.± 88.6	163.9±40.4	241.6±102.1
Relative muscle strength (kgf/kg)	3.70±1.2	2.50±0.7	3.08±1.2
Sedentary behavior time (1 workday) (min)	367.0±261.8	291.9±185.2	331.1±229.0
Sedentary behavior time (1 weekend day (min)	472.2±220.8	361.3±248.5	419.3±238.3

Values presented in mean and (±) standard deviation.

DISCUSSION

The aim of the present study was to investigate the level of physical activity of university administrative employees and compare it to MS and morphological structure indicators. The insufficiently active participants exhibited higher BM, lower LT, LLT, AMS, %MS and spent shorter time in physical activity on weekends. Sedentary behavior (insufficient physical activity) plays a crucial role in the development of several health problems, such as diabetes, hypertension, obesity, lipid profile abnormalities and musculoskeletal disorders. Physically active lifestyles present the opposite picture, therefore they provide a non-pharmacological strategy for prevention and treatment of these disorders[11-13].

Table 2. Comparison of physical activity levels, age, morphological characteristics, muscle time and sedentary behavior time, Guarapuava, Parana, Brazil, 2015 (n=44).

Variables	Insufficiently active (n=14)	Active (n=30)	p
Age (years)	37.3±10.9	37.5±12.1	0.955
Body mass (kg)	86.2±23.8	75.5±14.2	0.020*
Height (m)	1.73±0.1	1.71±0.1	0.297
Body mass index (kg/m^2)	28.3±5.4	25.6±3.5	0.050*
Right hand grip (kgf)	36.6±12.5	41.0±13.8	0.164
Left hand grip (kgf)	34.0±12.9	40.3±17.2	0.137
Lumbar traction (kgf)	61.6±34.8	86.3±35.0	0.009*
Lower limb traction (kgf)	69.0±37.4	92.8±45.8	0.042*
Absolute muscle strength (kgf)	201.3±92.2	260.4±102.4	0.015*
Relative muscle strength (kgf/kg)	2.3±0.9	3.4±1.1	0.001*
Sedentary behavior time (1 workday) (min)	431.4±315.4	284.3±161.4	0.042*
Sedentary behavior time (1 weekend day (min)	497.1±302.7	382.9±197.1	0.121

Values presented in mean and (±) standard deviation.

Sichieri et al.[14] analyzed leisure-time physical activity among 91 university employees. Their results corroborate those of the present study, as the less active women exhibited significantly higher (26%) BMI compared to the more active ones. In our study, MC (86.2±23.8 vs. 75.5±14.2 kg) and BMI (28.3±5.4 vs. 25.6±3.5 kg/m^2) were significantly higher among the insufficiently active participants compared to the active ones.

The BMI values exhibited by the insufficiently active group in the present study attained the range defining overweight. According to the Brazilian Obesity Guidelines[15], treatment for obesity is complex and depends on considerable lifestyle changes, including modifications in the diet and exercising.

According to Hadgraft et al.[16], office workers spend at least two thirds of the working time in sedentary activities. For this reason, employers have broadened the scope of incentives to healthy lifestyles, including diet, physical activity and reducing smoking, to improve the quality of life of employees. In the present study, the insufficiently active participants performed less physical activity during the week, a behavioral variable which needs to be included in daily life through due incentives.

The insufficiently active participants exhibited lower LT, LLT, AMS and %MS compared to the active ones. According to Tibana et al.[17], including strength training in physical activity programs is crucial for prevention and improvement of heart diseases. In addition, individuals with lower static and dynamic strength are at higher risk for accidents and musculoskeletal injury. Similar findings were reported in another study conducted with an obese population, in which the individuals with obesity exhibited lower strength levels and higher susceptibility to heart disease[18].

Other studies with similar results evidenced that the more physically active individuals exhibited higher lower limb isometric strength (p=0.001), higher lean mass and lower body fat percentage[19]. Therefore, strength and low body fat are paramount to improving the quality of life and preventing several chronic degenerative diseases.

%MS was significantly higher (p=0.001) among the physically active participants (3.4±1.1 kgf/kg) compared to the insufficiently active ones (2.3±0.9 kgf/kg). In regard

to the assessment of several health parameters, we observed that %MS should be used in intergroups comparisons, because it corrects the results for BM and BMI[20]. Obese individuals were found to exhibit higher MS, mainly in the lower limbs[21,22]. Cavazzotto et al.[23] reported that AMS for individuals with hypertension did not significantly differ from that for individuals with normal blood pressure, however, %MS was significantly different and BMI was 29.2 and 25.3 kg/m^2, respectively. Therefore, %MS is necessary to achieve a better understanding of the relationship between strength and health parameters[20].

Thus being, compliance with ongoing recommendations — performing at least 150 minutes of moderate-to-vigorous physical activity and resistance training twice per week — seems significant for the prevention of NCD and to control obesity[24]. Corroborating our data, physical activity seems to contribute to the control of the body fat and to increase/maintain muscle strength and resistance among university administrative employees.

CONCLUSION

The insufficiently active participants exhibited poorer MS indicators and higher BM, which indicates harms inherent to sedentary behavior.

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