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## ORIGINAL ARTICLE

### Resistive exercise training as an effective method to maintain lung function and functional capacity

### *Exercício físico resistido como método eficaz para manutenção da função pulmonar e capacidade funcional*

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#### Abstract

**Objective:** To evaluate pulmonary function and functional capacity in bodybuilding practitioners, comparing them with values predicted for the Brazilian population.

**Methods:** This is a cross-sectional, observational study, carried out among bodybuilding practitioners (N = 45) of both genders, aged between 20 and 60 years, with at least 4 weeks of training. Measurements of lung function (peak expiratory flow) and respiratory strength (maximum respiratory pressures) and functional capacity (6 minutes step test) were performed and compared to normal values predicted for the adult population. The significance level adopted was  $p < 0.05$ . **Results:** There was a statistically significant

difference for all outcome variables studied, except for peak expiratory flow values ( $p = 0.8471$ ). *Conclusion:* Weight training proved to be an effective method for maintaining maximal respiratory pressures and functional capacity.

**Keywords:** peak expiratory flow; functional capacity; physiotherapy.

## Resumo

*Objetivo:* Avaliar a função pulmonar e a capacidade funcional em praticantes de musculação, comparando-as com valores previstos para a população brasileira.

*Métodos:* Trata-se de um estudo observacional, transversal, realizado entre praticantes de musculação ( $N = 45$ ) de ambos os gêneros, com idade entre 20 e 60 anos, com pelo menos quatro semanas de treinamento. Foram realizadas medições da função pulmonar (pico de fluxo expiratório) e da força respiratória (pressões respiratórias máximas) e da capacidade funcional (teste do degrau de 6 minutos) e comparadas aos valores normais previstos para a população adulta. O nível de significância adotado foi  $p < 0,05$ . *Resultados:* Houve uma diferença estatisticamente significativa para todas as variáveis de resultado estudadas, exceto para os valores de pico de fluxo expiratório ( $p = 0,8471$ ). *Conclusão:* O treinamento com pesos demonstrou ser um método eficaz para manter as pressões respiratórias máximas e a capacidade funcional.

**Palavras-chave:** pico de fluxo expiratório; capacidade funcional; fisioterapia.

## Introduction

The benefits of a routine physical activity have been the target of several randomized clinical studies, which have demonstrated both improvement of the health status and an important ally to prevent serious diseases [1]. For other authors, there is a chance of reducing by up to 30% the occurrence of early death when performing three minutes of moderate to vigorous exercise or twelve minutes of light physical activity for every hour of daily sitting time [2].

Physical and mental health depends directly on cardiorespiratory resistance, which is known through measures of lung function and functional capacity, and should be encouraged even in gym environments, since tests in laboratories or specialized clinics often are not accessible to all professionals and/or the population [3].

It is notorious that weight training is more common today than it was some time ago; however, its effects on pulmonary mechanics and functional capacity are still unknown in the scientific community [4].

In this sense, the objective of this study is to evaluate measures of pulmonary strength, namely maximal inspiratory pressure (MIP), maximal expiratory pressure

(MEP), pulmonary function, through peak expiratory flow (PEF) and functional capacity, the latter measured through the 6 minutes step test (6MWT), comparing the values obtained with those predicted by the scientific literature, in a population of bodybuilding practitioners, with a minimum time of four weeks of activity.

## Methods

This is a cross-sectional observational study, conducted among bodybuilding practitioners (N = 45) of both genders and ages ranging from 20 to 60 years. The study took place from September to October 2022 in two cities in Serra Gaúcha (Parobé and Rolante) and was approved by the Research Ethics Committee FACCAT under opinion number 5.657.184.

The sample was chosen by convenience, provided it met the following inclusion criteria: volunteers enrolled in the sport, with a minimum of four weeks of physical activity, without any physical deficit that would prevent the tests from being performed, and who filled out the socio-epidemiological questionnaire. Volunteers with flu-like conditions, respiratory infections, asthma in the last month, recent thoraco-abdominal surgery (up to three months), and those who did not reach the minimum of three reproducible measurements in the pulmonary test, as well as lower limb orthosis users for whom the functional capacity test had to be adapted, did not participate in the study.

The measures of PEF were measured by means of the Peak Flow Meter instrument, from inspirations at vital capacity level followed by an inspiratory pause and forced expiration, following the recommendations of Conceição [5]. For the measurement of maximal inspiratory pressure (MIP), the volunteer was guided to perform forced expiration, put the device in the mouth and then perform a slow and deep inspiration (at the level of vital capacity), with an inspiratory pause of 2 to 3 seconds to record the measurement reached. For the maximum expiratory pressure (MEP) measurement, in turn, the volunteer was instructed to perform 2 to 3 ventilations at tidal volume followed by a slow and deep inspiration, and finally a maximum and sustained expiration. The procedures and values obtained were compared to those considered normal for the Brazilian population according to the study by Pereira [6].

The evaluation of functional capacity occurred through the 6-minute step test (6MWT): the volunteer was instructed to go up and down a step with width of 25 cm at his own pace and the highest possible speed for 6 minutes, as recommended by Ritt [7]. The value obtained was then checked against the predicted value from the following formula:  $TD6 = 348.4 + 48.48 \times \text{Gender (men=1, women=0)} - 1.29 \times \text{Age (years)} - 0.98 \times \text{Height (cm)}$  [8].

The results obtained were stored in a table in the Excel and then analyzed using the SPSS program. Data normality was tested using the Kolmogorov-Smirnov test. For the comparative analyses of lung function and functional capacity between the physical activity practices, we chose the Student's t test for independent samples. For the correlation analysis between gender, age, and time of activity with the variables studied, Pearson's correlation test was used.

## Results

Forty-five volunteers of both genders participated in the research; however, it was observed that there was a predominance of females, the medium level of education was the most prevalent (50%), and other socio-demographic aspects can be seen in Table I.

**Table I - Sample profile**

Female sex	55,55%
Age (years)	39,64 ( $\pm 10,69$ )
Schooling	middle level education (50%)
Frequency of activity	4x/per week (32%)
Marital status	Married (52%)
<b>Total</b>	<b>100%</b>

When the means between predicted and obtained values were compared for the outcome variables in this study, it was observed that only the PEF measurement did not show a statistically significant difference, as illustrated in Table II.

**Table II - Comparison of mean obtained and predicted values for lung function and functional capacity measures**

	Value obtained	Expected value	p
PEF	478 $\pm$ 134,37	483,65 $\pm$ 87,92	0,8471
MIP	82,95 $\pm$ 30,52	105,54 $\pm$ 19,25	0,00008*
MEP	115,22 $\pm$ 44,21	135,84 $\pm$ 52,85	0,004*
6MWT	209,22 $\pm$ 45,46	156,54 $\pm$ 32,58	0,001*

\*expiratory flow (PEF); maximal inspiratory pressure (MIP); maximum expiratory pressure (MEP); 6-minute step test (6MWT);  $p < 0,05$

In the study of the correlation of sociodemographic variables with those of the outcome for this research, we found moderate correlation between gender and MIP; strong correlation between gender and PEF, and perfect correlation both between age and time of activities in sports for the same measure of PEF (Table III).

**Table III** - Correlation of age, sex, and frequency of physical activity with lung and functional capacity variables

	PEF	MIP	MEP	6MWT
Gender	-0,7649 <sup>+</sup>	-0,4544 <sup>+</sup>	-0,2369	-0,2631
Age	1 <sup>**</sup>	0,0333	0,1509	-0,3178
Frequency of activity	1 <sup>**</sup>	0,2240	0,0599	0,3204

\* moderate correlation; + strong correlation; \*\*perfect correlation

## Discussion

It is known that pollution in large urban centers, the presence of a sedentary lifestyle, the growing number of obese individuals, and professional stress are factors closely related to the increased occurrence of cardiovascular diseases and the consequent increase in morbidity and mortality worldwide. In this sense, numerous studies have been conducted in order to direct public policies. In Canada, for example, a study indicated that only 15% of Canadians perform 150 minutes of moderate to high intensity physical activity per week, which is the minimum acceptable time in that country [9]. A Brazilian survey, in turn, conducted in 2014, revealed that 33.5% of the population exercises during leisure time, but not daily [10].

It is known that the population present in gyms is young, healthy, and the overwhelming majority is unaware of the real benefits of a routine of physical activity on lung function [11]. The people who frequent these spaces do not imagine that moderate to high intensity resistance training not only promotes body weight control, but also exercises influence on the cardiovascular demands [12]. According to Tiler *et al.* [13], upper and lower limb exercises performed in healthy individuals usually generate neurological stimuli capable of influencing ventilatory mechanics, and thus promote greater chest expansion, lower respiratory rate during exercise and greater oxygen uptake.

Our findings also pointed to a statistically significant difference between the predicted measurement and that obtained for the measurements of maximum respiratory pressures (Table II), reinforcing the idea that physical training performed in a gym environment can maintain or even increasing pulmonary function tests. Similar results have already been reported in scientific literature, such as in the study by Han *et al.* [15], who observed a statistically significant increase in MEP of elderly women treated with strength training for upper and lower limbs, during a relatively short time of 6 weeks of treatment. Salcedo *et al.* [16] performed a meta-analysis study from systematic reviews that quantified the effect of physical training on pulmonary function indices in adults with COPD and found significant improvement in spirometric values when compared to the control group.

On the contrary, our study also pointed out that there was no statistically significant difference in the comparison between the predicted and obtained values for PEF measurement. The authors believe that this measurement can be more influenced in a younger age group than the one studied in this sample, as observed in the study by Xavier *et al.* [17], who applied aerobic exercises combined with resistance exercises among 40 adolescents, over 12 weeks, and observed that the strategy was able to increase both MIP and PEF.

In our study, we found a huge influence of age and frequency of training on PEF and MEP measurements (Table III). This fact had already been mentioned in the work of Earnest *et al.* [18], who demonstrated that resistance training combined with aerobic training could be an effective strategy both to improve cardiorespiratory fitness and to prevent the consequences of metabolic syndromes, such as type II diabetes, since the preservation of muscle function becomes increasingly important with age. The same is valid for cases of severe diseases, as reported by Dieli-Conwright *et al.* [19], when treating post-mastectomized women by means of resistance and aerobic exercises, performed three times a week, over 16 weeks and they observed improvement in the quality of life, reduction of depressive factors, and increase in the pulmonary function.

The scientific literature has pointed out that a routine of physical activity can both prevent serious diseases, such as heart attack, and treat them. This is the case of Chronic Obstructive Pulmonary Disease (COPD), which usually presents reduction of symptoms and improvement of pulmonary function when programs composed of resistance exercises of upper and lower limbs are instituted [20]. Another study also emphasized that physical activity, regardless of the modality chosen, when exercised at least four times a week, was effective in improving the complaint of fatigue, raising the quality of life indices, increasing lung function, muscle mass and strength in patients with lung cancer [21].

The authors point out as limitations of this study the sample size considered small, given the number of students enrolled in the invited spaces, and finally, the absence of a control group for further extrapolation of their findings.

## Conclusion

Weight training proved to be an effective method for maintaining maximal respiratory pressures and functional capacity. Regarding the only outcome variable that did not show statistical significance (PEF), there was an important influence of gender, age, and the time in which the physical activity is exercised.

Because it was a small sample and in the absence of a control group, the authors point out that the data may not be extrapolated to the general population, and they recommend that other studies be conducted in this regard.

**Conflito de interesses**

Não há conflito de interesses entre os autores e nem destes com o artigo em questão.

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Próprio

**Contribuição dos autores**

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