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ORIGINAL ARTICLE

Regular physical activity improves lung function and muscle strength of respiratory wheelchair

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Abstract

The objective of this study is to analyze the influence of physical activity under Pulmonary Function and Respiratory Muscular Strength in sedentary, practicing basketball and swimmers, comparing predicted values with those performed. For this, the method used was a cross-sectional, prospective, comparative study, in which 15 wheelchair users were evaluated, five swimming practitioners, five basketball practitioners and five sedentary workers. The evaluation form, pulmonary function test (spirometry) and respiratory muscle strength test (manovacuometry) were used. The results of the research indicate that the sedentary group presented a statistically significant difference ($p < 0.05$) between the predicted and realized values for: Vital Capacity (CV), Forced Vital Capacity (FVC), and Inspiratory and Maximum Expiratory (Pimax and Pemax). In the swimming and basketball groups there was a significant difference ($p < 0.05$) only for the PeMáx variable. From the study, it was concluded that sedentary individuals presented values below predicted, generating a greater number of variables with significant differences. Considering these results, it is argued that the practice of regular physical activity positively affects pulmonary function and respiratory muscle strength in wheelchair users.

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INTRODUCTION

Extensive studies reveal that the practice of physical activity improves the functionality and quality of life of people with physical disabilities, thus promoting disease prevention and health maintenance. The paradesporto (a sport modified or created to serve people with disabilities) is indicated from the initial phase, as it acts as a cooperator in the rehabilitation process. This professional works not only for the therapeutic benefits, but also for the psychological and social results[1].

The regular sports practice positively collaborates to the functions of the organism, improving aerobic capacity and pulmonary mechanics. On the other hand, sedentarism contributes to the reduction of pulmonary volumes, mainly the reduction of the volume of expiratory reserve, forced expiratory volume in the first second (FEV1), forced vital capacity (FVC)[2].

Studies indicate that, in Brazil, 56% of women and 37% of men are sedentary. These statistics not only affect the reduction of respiratory pressures, but also counteract the practice of physical activity, linked to the prevention of comorbidities[1,3].

When compared with swimming athletes, sedentary individuals present significant differences of PiMáx and PeMáx. This occurs because the respiratory system changes in response to exercise, due to the increased diffusion capacity of the membrane and the blood volume in the capillaries[4].

The factors that contribute to pulmonary function are the thoracic and abdominal musculature, and the posture of the individual. It is already known that the posture affects the activity of the abdominal muscles that are also active in the exercises and the expiration[5,6].

The capacity of respiratory muscles reduction in generating force can directly influence the performance of the physical activity, contributing to a mechanical restriction of the pulmonary ventilation. Corroborating this, a study shows that respiratory muscle weakness led to a decrease in vital capacity (CV)[7].

People who used bronchodilators and practiced swimming twice a week for 6 months, had a significant increase in FEV1, FVC, and peak expiratory flow (PEF) parameters. On the other hand, for those who only used this medication, the significant change occurred only in VEF_1[8].

Two very efficient methods for checking lung capacity are spirometry and manovacuometry. These methods consist of non-invasive tests that measure pulmonary volumes and capacities and respiratory muscle strength respectively, serving to analyze both functional capacity and physical performance[9].

Thus, as the benefits related to the practice of physical activity by wheelchair users are poorly described and understood in the literature, the justification for this study is based on the importance of encouraging physical activity to sedentary wheelchair users, as well as on the interest in inserting evaluative methods

of pulmonary function and respiratory muscle strength in adapted sport, contributing to better performance of athletes in training and competitions.

The aim of the study is to analyze the influence of physical activity on Pulmonary Function and Respiratory Muscular Strength, comparing the predicted and realized values in practicing and non-practicing physical exercisers.

METHOD

This is a cross-sectional, prospective, comparative study in which 15 wheelchair users were evaluated, 5 swimming parathletes, 5 basketball players and 5 sedentary ones. The research was conducted with athletes enrolled in the Training Center of Clube Álvares Cabral and of the Rehabilitation and

Sports Institute for Physical Disabilities of Espírito Santo by signature of the Letter of Consent.

It were included individuals of both genders, aged between 18 and 45 years, restricted to the wheelchair, practicing or not regular physical activity, who are over 6 months in the modality, and who agreeded to sign the Free and Informed Consent Term .

Those who had cardiovascular or cardiorespiratory changes were excluded; Presence of postural changes such as severe kyphoscoliosis; Motor and cognitive alterations that made it impossible to perform tests and smokers.

To begin with, an interview was held in which the participants completed an evaluation form prepared by the researchers. The data collected were: personal data (name, gender, race and age), life habits (alcoholism and smoking), clinical data (type of disability, time of use of a wheelchair, associated conditions, time of practice Sport and training volume) and physical examination (height measurement by means of the wingspan), in order to characterize the profile of the sample.

Shortly thereafter, the evaluation protocol was used to obtain the respiratory variables in relation to lung function (volumes and capacities) and respiratory muscle strength (inspiratory and expiratory).

The pulmonary function evaluation was carried out to identify the tidal volume (CV), CV, FEV1 and FVC, and the FEV1 / FVC ratio. For this purpose, we used a New Diagnostic Design spirometer and Easyon-PC model. The test was performed according to the Guidelines for Pulmonary Function Tests of 2002[10].

In order to obtain the values of respiratory muscle strength, it was decided to use inspiratory (PiMáx) and expiratory (PEmax) pressures by means of a WIKA manovacuometer and model 611.10.063. The values were obtained from the Residual Volume (VR) and Total Pulmonary Capacity (CPT), and the highest values were considered for analysis. The expected maximum respiratory pressures were calculated using the equations proposed by Neder[11].

Statistical analysis was carried out in the SPSS version 23 program. As a result of the number of observations, non-parametric Mann-Whitney test-based statistics were applied, considering levels of significance $p < 0.05$. In the descriptive analysis, the variables with normal distribution were presented by mean and standard deviation, the ordinal or asymmetric by median, maximum and minimum, being the nominal ones represented with frequency and percentage.

RESULTS

The sample was composed of 15 (fifteen) participants, of whom 4 (four) were female and 11 (eleven) were male. The profile of the individuals evaluated can be seen in table 1, where it is possible to observe that the sedentary group, because it presents a higher prevalence of low lesions, (7 individuals), so they should not have respiratory damages related to the type of injury. In contrast, when compared with the group of athletes, these sedentary individuals presented greater respiratory compromise.

With regard to the time of use of wheelchair, the practitioners of physical activity presented more average time in the seated posture, but presented higher average performance in the respiratory system than the sedentary ones.

Table 1 – Sample characterization

	N = 15	Practitioners of physical activity (N=10)	Sedentary (N=5)
Age (mean ±SD) in years	32,1 (± 6,94)	34,7 (± 6,76)	27 (± 4)
Height (mean ±SD) in meters	1,64 (± 0,09)	1,68 (± 0,09)	161 (± 0,06)
Smoking N (%)			
Smoker	0 (0%)	0 (0%)	0 (0%)
Ex-smoker	7 (46,7%)	5 (50%)	2 (40%)
Smoking time (mean ± SD) in years	4,20 (± 5,35)	9,25 (± 4,57)	0,8 (± 1,78)
Drinking N (%)			
Drinker	4 (26,7%)	3 (30%)	1 (20%)
Ex-drinker	11 (73,3%)	3 (30%)	1 (20%)
Type of Injury N (%)			
Tetraparesis	3 (20%)	3 (30%)	0 (0%)
Paraparesis	5 (33,3%)	0 (0%)	5 (100%)
Paraplegia	7 (46,7%)	7 (70%)	0 (0%)
Wheelchair usage time median (min -max) in months	144 (7 - 360)	174 (26 – 360)	20 (7 – 144)
Exercise time median (min -max) in months	50 (0 - 144)	72 (20 – 144)	–
Training Duration median (min - max) hours/week	9 (0 - 12)	9 (4 – 12)	–

The predicted and performed values of lung function and respiratory muscle strength variables within each group are listed in table 2. In the swimming and basketball groups, the Wilcoxon test pointed out a significant difference particularly for the PeMáx variables ($p < 0.05$) between the predicted and the performed, and in the sedentary group the same test indicated significant difference CV, FVC, PiMax and PeMax ($p <0.05$).

Table 2 – Pulmonary Function and Respiratory Muscular Strength

	SWIMMING		BASKETBALL		SEDENTARIES	
Variables	**Projected**	**Achieved**	**Projected**	**Achieved**	**Projected**	**Achieved**
CV (L)	0 ± 0	0,86 ± 0,30	0 ± 0	1,17 ± 0,80	0 ± 0	0,86 ± 0,26
VC (L)	3,82 ± 0,68	3,76 ± 1,12	4,41 ± 0,96	3,07 ± 1,01	4,31 ± 0,43	2,77 ± 0,91*
IC (L)	2,89 ± 0,69	2,66 ± 0,77	3,26 ± 0,97	2,52 ± 0,69	3,05 ± 0,45	2,02 ± 0,71
FVC (L)	4,10 ± 0,80	3,8 ± 1,23	4,41 ± 0,96	3,17 ± 1,01	4,31 ± 0,43	2,76 ± 0,92*
FEV_1 (L)	3,21 ± 0,53	3,11 ± 0,87	3,75 ± 0,80	2,53 ± 0,97	3,71 ± 0,36	2,38 ± 1,07
FEV_1/FVC	0,83 ± 0,01	0,83 ± 0,05	0,85 ± 0,02	0,79 ± 0,11	0,86 ± 0,01	0,84 ± 0,16
PiMax	139 ± 23,24	102 ± 26,83	134 ± 21,55	94 ± 36,47	147 ± 3,13	96 ± 25,10*
PeMax	150 ± 26,37	97 ± 16,43*	144 ± 25,43	90 ± 20,00*	160 ± 3,50	66 ± 32,09*

IC = Inspiratory capacity ; VC = Vital capacity; FVC = Forced Vital Capacity ; PeMáx = Maximum Expiratory Pressure; PiMáx = Maximum Inspiratory Pr; CV = Current Volume ; FEV1 = Expiratory Volume in the First Minute. Data Expressed in Mean ± Standard Deviation. * P<0.05.

DISCUSSION

A study found that sedentary individuals present significant differences of PiMáx and PeMáx when compared with swimming athletes. This happens because the immersion of the thorax provides the combined effects of hydrostatic pressure, density and compressibility, potentiating the respiratory musculature[4].

This study found some differences in the values of the muscular strength of the sedentary ones compared with the swimmers. Nevertheless, no statistical difference was noticed.

Nevertheless, respiratory musculature weakness in spinal cord injured patients results in poor lung performance, directly influencing volumes and capacities[7].

Likewise, there was a significant reduction in the values of PiMáx and PeMáx in the sedentary group, demonstrating that the presence of respiratory muscle weakness, which leads to a considerable decrease in CV.

Paulo, Petrica and Martins (2013) found that sedentary lifestyle compromised pulmonary volumes and capacities, considering that inactivity may influence body composition and may possibly lead to decreased pulmonary complacency and increased airway resistance[2].

It was observed that there was a significant decrease in CV and FVC in the sedentary group, which represents important variables in relation to pulmonary function, corroborating with the study cited above.

The practice of regular physical activity over 6 months promotes expressive changes in parameters of FEV 1 and FVC[8].

The average time of sports practice among participants 'practitioners of physical activity' in the study was 6.4 years. Nonetheless, there were no significant differences in $FEV_1$and FVC values.

There are many factors that influence pulmonary function, altering diaphragmatic mechanics, and among them is the posture[5,6]. This study showed that the time of use of the wheelchair among physical activity practitioners was greater than that of the Sedentary group. Thus, it was observed that despite the respiratory mechanics being influenced, because of the posture adopted by the wheelchair, there were no significant losses in the pulmonary function of the athletes.

The level of injury establishes its type and severity, because the higher the lesion, the greater the motor and respiratory consequences[7]. Higher injury levels were found in the groups practicing physical activity, which could lead to a greater respiratory compromise. Nonetheless, we did not find great negative repercussions on pulmonary function when compared with the sedentary ones, who present lower injury levels and, nevertheless, a greater impairment of the pulmonary function. Therefore, we believe that sports practice provides better respiratory conditioning.

CONCLUSION

Participants of physical activity showed a better pulmonary performance when compared to the sedentary ones. Comparing the predicted and performed values within each group, sedentary individuals presented values below predicted values. Therefore, we conjecture that wheelchair users, who do not practice physical activity, have a loss of lung function, and may have repercussions with secondary affections due to sedentary lifestyle.

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