International Journal of Research in Medical Sciences
Awad KM et al. Int J Res Med Sci. 2017 Jun;5(6):2516-2518
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20172439

Original Research Article

Effect of physical training on lung function and respiratory muscles strength in policewomen trainees

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Received: 02 April 2017
Accepted: 28 April 2017

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ABSTRACT

Background: Measurement of respiratory muscles strength has not been widely investigated in the context of physical training.
Methods: This cross-sectional study has assessed pulmonary function and strength of respiratory muscles in two women groups: group I includes healthy policewomen (n=28) exposed to physical training 3 hours daily for at least 2 years and group II is a matched control group (n=31) of untrained apparently healthy second year medical students. Lung function tests including forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and peak expiratory flow rate (PEF) were performed using a digital spirometer and maximum inspiratory and expiratory pressures (MIP and MEP) as indicators for respiratory muscle strength were measured using a digital respiratory pressure meter.
Results: The mean FVC (L), FEV1 (L), PEF (L/min) values were significantly higher in the police-trained group (p=0.000, 0.000 and 0.003 respectively). Similarly, the mean MIP and MEP (cm/H_2O) values were significantly higher among trained group (p=0.000 and 0.003 respectively).
Conclusions: Long-term regular physical exercise improves lung function as well as respiratory muscle power and may delay the age-related decline in lung function.

Keywords: Exercise, Lung function, Physical training, Respiratory muscle power

INTRODUCTION

Exercise is a stressful situation that produces marked changes in body functions including the respiratory system. Physical inactivity is directly related to morbidity and mortality from many diseases.[1] Therefore, physical training is one of the major bases for good health and wellbeing and currently globally recommended.[2] During exercise the body′s demand for oxygen increases as the breathing must also rise. This requires numerous muscles surrounding the lungs to contract in a highly coordinated manner. As the intensity of exercise increases, the respiratory muscles contract more forcefully and quickly to keep pace with the increase in oxygen demand. Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) are useful indices for assessment of respiratory muscles performance in adults as well as in children.[3] Training of the respiratory muscles increases their strength and improves lung function and was found to reduce the severity of obstructive sleep apnoea in cervical spinal cord injury and improves breathing pattern in patients with COPD.[4,5]

Several cross-sectional and cohort studies have shown significant improvement of lung function as a result of exercise in both children and adolescents.[6-9] However, measurement of respiratory muscles strength has not been widely investigated in relation to physical training. In this context, the present study aimed at assessing pulmonary function as well as respiratory muscles strength among policewomen trainees compared to healthy untrained sedentary group of medical students.

METHODS

The cross-sectional study included two groups: Group I (n=28) policewomen trainees exposed to different types of moderate to severe physical exercise for 3 hours daily for 2-3 years. Group II (n=31), a control group of apparently healthy second year female medical students with sedentary lifestyle. The two groups have the same ethnic class and were matched for age, height and weight measured using standard British scales. Both groups are free of disease symptoms and lifelong non-smokers. Lung function tests including forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and peak expiratory flow rate (PEF) were performed to all subjects using a Digital Spirometer Manufactured by Micromedical Limited (UK).

The procedure was first explained to the subject; ensuring that she was standing erect with feet firmly on the floor, then was asked to take a deep breath (maximum inspiration to the total lung capacity) and expire forcibly and as long as possible into the spirometer. The best reproducible results of FVC, FEV1 and PEF according to the ATS/ERS standards were recorded. The strength of the respiratory muscles was assessed in all subjects under the study using a Respiratory Pressure Meter (MicroRPM). The MicroRPM is a hand-held instrument designed for rapid assessment of inspiratory and expiratory muscle strength by measurement of the mouth pressures: Maximum Expiratory Pressure (MEP) and Maximum Inspiratory Pressure (MIP). For MIP test: after fitting the mouth piece the subject was asked to exhale to residual volume then perform a forced inhalation against the MicroRPM with as much effort as possible for as long as possible. For MEP test: the subject was asked to inhale to the total lung capacity, and then perform a forced exhalation against the MicroRPM as maximum and long as possible. Each test was repeated 3 times with the same standard method and the best value was recorded.

The obtained data were analyzed using SPSS program (Version 16; Chicago, IL, USA). Variables were described by means and standard deviations (SD). Independent student's T test was used to compare the mean difference between the two groups. A value of $p<0.05$ was considered significant. The study was ethically cleared by the ethics review committee at the Faculty of Medicine, National Ribat University, Sudan. All volunteers provided informed written consent before being involved in the study.

RESULTS

Fifty-nine subjects were included in the two matched groups. The mean age (year), height (cm), weight (Kg) and MBI (Kg/m^2) of the policed-trained group were 20.96±0.88, 162.54±5.73, 58.04±8.27 and 21.96±2.89 respectively while in the untrained medical students were group were 19.45±1.52, 163.88±8.00, 57.19±11.37 and 21.25±3.58 respectively (Table 1).

Table 1: Mean age, height, weight and BMI in police-trained group (trainee) and the control group (sedentary medical students).

Parameter	Trainee group (n=28) Mean±SD	Control group (n=31) Mean±SD
Age (years)	20.96±0.88	19.54±1.52
Height (cm)	162.54±5073	163.88±8.00
Weight (kg)	58.04±8.27	57.19±11.37
Body mass index (BMI) (Kg/m^2)	21.96±2.96	21.25±3.58

Mean values of FVC (L), FEV1 (L), PEF (L/min), MIP and MEP (cm/H_2O) for trainees were: 2.70±0.55, 2.41±0.46, 286.11±66.49, 56.89±15.40 and 76.53±14.82 respectively while in untrained were: 2.03±0.47, 1.93±0.45, 249.45±87.61, 44.03±17.55 and 47.48±19.43 respectively. Comparing the two groups showed FVC, FEV1, PEFR, MEP and MIP were significantly higher ($p<0.05$ for all parameters) in police-trained group, (Table 2).

Table 2: Mean values of ventilatory and respiratory muscle strength indices in police-trained group (trainee) and the control group (sedentary medical students).

Parameter	Trainee group (n=28) Mean±SD	Control group (n=31) Mean±SD	p
FVC (L)	2.70± 0.55	2.03± 0.47	0.000
FEV_1 (L)	2.41±0.46	1.93± 0.45	0.000
PEF (L/min)	286.11±66.49	249.45± 87.61	0.003
MIP (cm/H_2O)	56.89±15.40	44.03±17.55	0.004
MEP (cm/H_2O)	76.53±14.82	47.48± 19.43	0.000

DISCUSSION

To the best of our knowledge, this is the first study to be focused on MEP and MIP variation in Sudanese women athletes. The results of the present study were measured and compared among the two groups and also with the studies carried out previously. The values of lung volumes (FVC, FEV1 and PEF) as well as respiratory muscle strength indicators (MEP and MIP) were found to be significantly higher ($p<0.05$ for all) in policewomen trainee group when compared with results obtained for sedentary medical students' group. The higher values in lung function parameters could be attributed to the improved strength of respiratory muscles proved by higher values of MEP and MIP in trained subjects (Table 2). Present results are in consistency with the literature regarding the association between physical activity and lung function.[6-9] Different types of exercise can improve lung function. In a review article, pulmonary function appears to improve with a minimum of 10 weeks of regular yoga practice.[10] Swimming exercise can also improve lung function; a study conducted among adolescent swimmers revealed higher spirometric values (FVC, FEV1 and PEF) above percentage of their predicted values.[3] Another supportive study comparing active versus inactive groups was conducted by António B who included 52 women: 27 were engaged in a gymnastics program for 3 hour a week, for at least 2 years and 25 were age matched control group.[11] MEP was significantly higher in the active group. Nevertheless, the MIP was also higher in the active women group but statistically insignificant. In a study conducted in healthy subjects, it was observed that high intensity inspiratory muscle training increases the diaphragm thickness, lung volumes and exercise capacity in trained people, a result consistent with our study findings and supports the fact that training of respiratory muscles improves lung function.[12] Moreover, a high level of physical activity was found to overcome the disadvantages of a decline in lung function with increasing age a result that supports the benefits of regular and long term physical activity.[13]

CONCLUSION

Regular long term physical exercise improves lung function which is likely due to improved respiratory muscles power that aids a better chest expansion. Regular physical activity should be encouraged as it may delay the age-related decline in lung function and respiratory muscle power. MEP and MIP are suggested being used as sensitive tools for athletes' performance.

ACKNOWLEDGEMENTS

Authors would like to thank the Police College trainees and medical students at National Ribat University, Khartoum, Sudan, from which data used in this study were gained.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Awad KM, Magzoub A, Elbedri O, Musa OA. Effect of physical training on lung function and respiratory muscles strength in policewomen trainees. Int J Res Med Sci 2017;5:2516-8.