Short Communication

Spirometry Changes in Cold Climatic Conditions of Antarctica

Iyamanda B. Udaya[1], Chettangada C. Laxmi[2], Hulegar A. Abhishekh[3], Trichur R. Raju[3] and Talakad N. Sathyaprabha[3]

Institute of Aerospace Medicine[1], BGS Global Institute of Medical Sciences[2] and National Institute of Mental Health and Neurosciences[3], Bangalore, India

Abstract

Background. Pulmonary function is one of the important physiological measures that is known to be affected during the changes in the altitude. There is dearth of literature on changes in the pulmonary function variables in the cold climate conditions of Antarctica. We carried out spirometry before, during and after one year stay at Antarctica in members of the Indian expedition.

Methods. Spirometry was carried out on 23 members of the XXVI Indian Scientific Expedition to Antarctica at baseline, after six months of expedition and at the end of one year, using standard guidelines. The tests were carried out indoor in temperature controlled laboratory.

Results. The pulmonary function test parameters did not vary across the period. Although, both forced vital capacity (FVC) and forced expiratory volume in first second (FEV_1) showed a decreasing trend but did not attain any statistical significance. However, peak expiratory flow (PEFR) rate was reduced significantly.

Conclusion. Our study did not show consistently significant change in the pulmonary function parameters in the members of the Indian Antarctic expedition. **[Indian J Chest Dis Allied Sci 2015;57:259-260]**

Introduction

Environmental conditions in the Antarctica are analogous to space.[1] Unusual aspects of the continent include harsh climates, extreme cold and unusual meteorological phenomena. Human physiological data collected in this setting might help us to understand the adaptation of human internal environment to such situations. This information will also be of use to study the effects of such an exposure in members of expeditions. Previously, authors have reported increased airway resistance on exposure to cold environment.[2] There is dearth of literature on changes in the pulmonary function variables in Antarctica expedition members. We carried out a one year study of pulmonary function test in the Indian Antarctica expedition members to examine if there are any adverse consequences.

Material and Methods

Spirometry was carried out in 23 members of XXVI Indian Scientific Expedition to Antarctica who wintered over in India's second permanent research base Maitri, located in Schirmacher Oasis in Antarctica (Latitude: 70^0 45' 01.65" S and Longitude: 11^0 43' 01.45" E). It was situated 337ft above mean sea level.

All expedition members of the team were included and thoroughly screened for any medical illness. None of the participants were on any medication. The study was approved by the Institutional Ethics Committee. Informed consent was taken from all the participants.

The first lung function study was done at National Center for Antarctic and Ocean Research, Goa, India thereafter recordings were done in mid-expedition (mid-winter period; 6 months after stay in Maitri) and the end expedition (12 months after stay in Maitri). The last measurement was done in the Antarctic before returning. The subjects were maintained on a diet supplying about 3500Kcal during winters and 4000Kcal during summers which was consistent with their physical activity. During the polar nights, their outdoor activities were restricted to minimal essential duties only. After obtaining the age, height, weight and other relevant history, the subjects were explained the procedure and demonstrated.

The subjects were rested in medical inspection room maintained at 24±2 °C for 15 minutes on a chair with arm rests. Spirometry values of FVC, FEV_1 and PEFR were obtained using a hand-held PC based pneumotachometer (Quark model, Cosmed, Italy). The equipment was calibrated regularly as per the OEM and American Thoracic Society guidelines. Further details of the pulmonary function test can be found elsewhere.[3-5] Mean and standard deviation were estimated for demographic variables. Pulmonary function test data was analysed using repeated measure analysis of variance (RMANOVA). A p value less than 0.05 was considered as statistically significant.

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Correspondence and reprint requests: Dr T.N. Sathyaprabha, Professor, Department of Neurophysiology and In-Charge, Autonomic Lab, National Institute of Mental Health and Neuro Sciences (NIMHANS), Hosur Road, Bangalore-560 029 (Karnataka), India; E-mail: drsathyaprabha@gmail.com

Results

Mean age of the subjects was 38.1±1.6 years (range: 28-56). Mean height and weight of the group was 1.7±0.01 meters and 69.7±1.4 Kg, respectively. The mean body mass index was 24.5±0.4 (range: 20.8-27.6]. There were three smokers among the subjects.

Although FVC and FEV_1 showed a decreasing trend, these did not attain statistical significance. Peak expiratory flow rate was reduced significantly. On post-hoc test, a decrease was seen at both follow-up time points. The FEV_1/FVC (%) and tidal volume did not change across the period (*see* Table).

Discussion

To the best of our knowledge, this is the first study to investigate long-term pulmonary function changes in the Antarctica expedition members. Our study did not find any significant changes in the pulmonary function parameters except in PEFR. Data supports the notion that lung function adapts to changes in the Antarctica without any permanent or persistent change. Physical factors like hypobaric environment and extreme cold vary in Antarctica.[6] However, it is plausible that lungs acclimatise through physiological mechanisms that might include relaxation of the upper airway and increased muscle power, and decreased oxygen uptake.[7,8] Previously, Bandopadhyay and Selvamurthy[7] studied respiratory changes in Arctic environment. They showed alteration in the pulmonary function parameters in the first four weeks that was subsequently normalised. Our study corroborates these observations.

One important limitation was that spirometry was carried out at comfortable room temperature and not in the harsh sub-zero temperatures. It leaves the possibility that lung function may have been affected during cold air-induced hyperventilation and bronchospasm, if the assessment was carried out in the open environment. Future studies should address this issue. In conclusion, with the current expedition protocol no significant alteration of pulmonary function was noted.

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Table. Pulmonary function test parameters during pre, mid and post expedition

Pulmonary Function Parameter	Pre-expedition (n=23)	Mid-expedition (n=23)	Post-expedition (n=23)	p value
Forced vital capacity (L)	3.6±0.6	3.4±0.7	3.4±0.7	>0.05
Forced expiratory volume in 1 second (L)	3.0±0.4	2.8±0.5	2.8±0.5	>0.05
Peak expiratory flow rate (L)	7.7±2.07	7.0±1.8	6.4±1.8	<0.05*
FEV1/FVC(%)	83.7±7.9	83.0±8.9	84.6±8.3	>0.05
Tidal volume (mL)	472.1±129	496±178	461±126	>0.05