

Differences in computerised respiratory sounds of nonsmokers and smokers.

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Abstract

Smoking is often associated with the development of acute and chronic respiratory diseases. However, if detected early, the changes in the pulmonary tissue caused by smoking may be reversible. Computerised respiratory sounds, namely crackles, have shown to be sensitive to detect changes within the pulmonary tissue, however it is unknown if it allows to detect early changes in the lungs of healthy smokers. Results showed that smokers presented more fine crackles than non-smokers. Fine crackles are often the earliest sign of disease. Thus, crackles might be a promising measure to early detect respiratory diseases in smokers.

Background

Cigarette smoking is often associated with inflammation, obstruction and destruction of the lung parenchyma and airways¹, which potentiate the development of acute and chronic respiratory diseases². However, if detected early, the changes in the pulmonary tissue caused by smoking may be reversible with optimal management³. Computerised respiratory sounds, namely crackles, have shown to be sensitive detecting changes within the pulmonary tissue before any other measure⁴, however it is unknown if it allows to detect early changes in the lungs of healthy smokers. This study aimed to compare crackles between non-smokers and smokers.

Methods

Healthy non-smokers and smokers were recruited from a University Campus. Socio-demographic (age, gender) and clinical (smoking status, body mass index and lung function) data were first collected. Then, respiratory sounds were recorded simultaneously in 6 chest locations (right and left: anterior, lateral and posterior regions) using air-coupled electret microphones. Airflow was standardised (1.0-1.5 l/s) and recorded with a pneumotachograph. Breathing phases were detected using the airflow signals and crackles with developed and published algorithms. Descriptive statistics were used to describe the sample. Socio-demographic and clinical characteristics were compared between groups with Independent Samples t-tests for continuous data and Fisher's exact tests for categorical data. For each chest region (anterior, lateral and posterior), the results from the right and left locations were pooled and comparisons between groups were performed using Mann-Whitney U tests. Data are shown as mean ± standard deviation or median [interquartile range].

Results

Thirty-two participants were enrolled: 19 non-smokers (25.05 ± 3.42y; FEV₁ 101.67 ± 11.60% predicted) and 13 smokers (24.08 ± 9.99y; FEV₁ 102.50 ± 8.17% predicted). Participants' characteristics are presented in Table 1. Groups presented no differences regarding age, gender, body mass index and lung function (p > .05) and smokers presented a median of 2.4 [1.2-5.4] packs/years. Smokers presented significantly more inspiratory fine crackles (0.20 [0.12-0.40] vs. 0.12 [0-0.27], p=0.010) at anterior region and expiratory fine crackles at posterior region (0.50 [0.29-0.91] vs. 0.33 [0.17-0.50], p=0.015). No significant differences were detected at lateral regions. Detailed results are presented in graphs 1, 2 and 3.

Conclusion

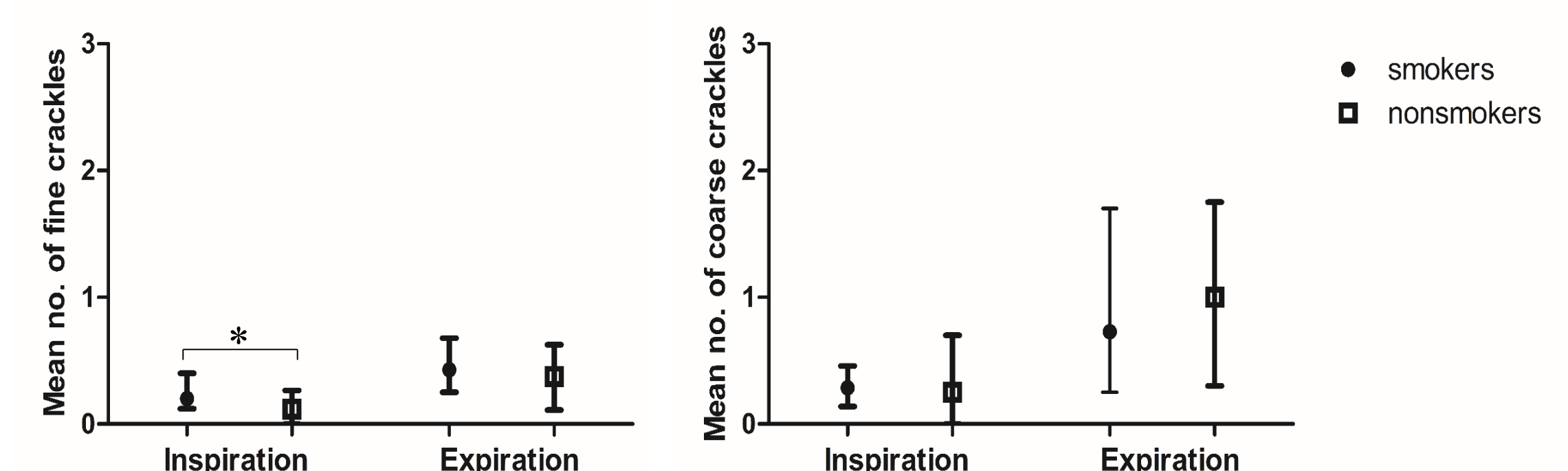
Smokers presented significantly more fine crackles, than non-smokers. Fine crackles are often the earliest sign of disease, present even before detection of changes on radiology⁵. Thus, crackles might be a promising measure to early detect respiratory diseases in smokers.

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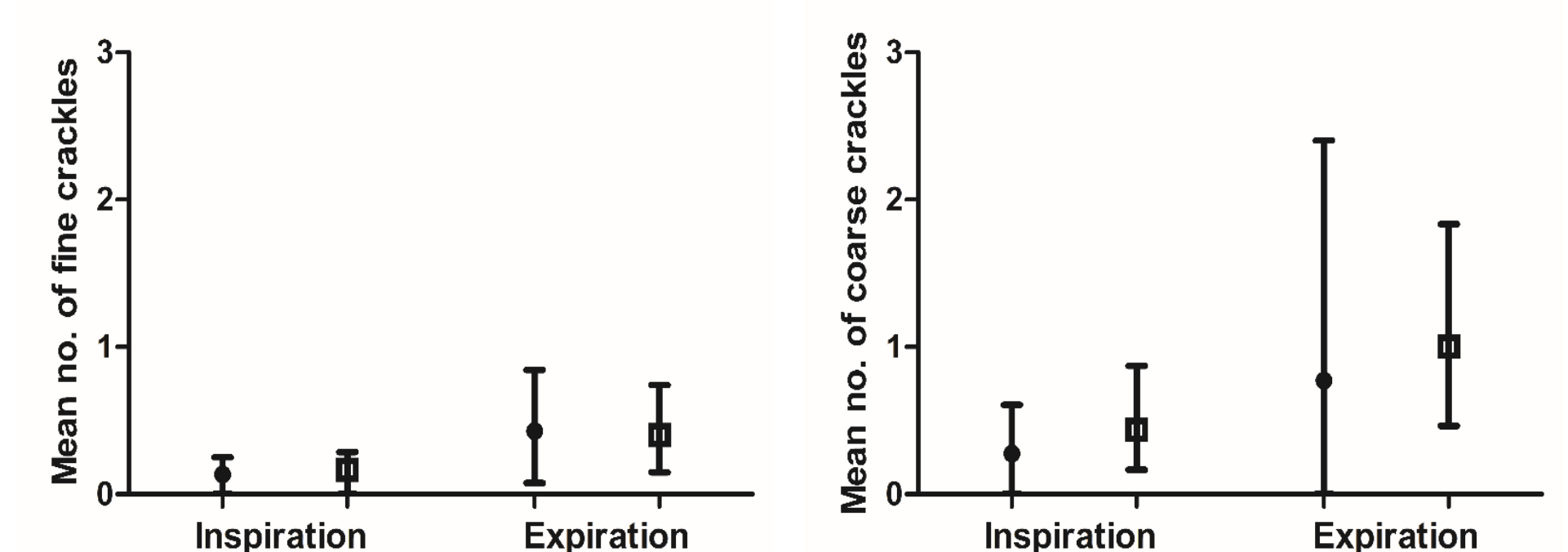
Table 1. Participants' characteristics.

Characteristics	Non-smokers (n=19)	Smokers (n=13)	p
Age (years)	25.05±3.42	24.08±9.99	0.695
Gender (male), n(%)	13(68%)	8(62%)	0.687
Packs/year, M[IQR]	-	2.4 [1.2 - 5.4]	-
BMI (kg/m ²)	22.52±2.25	23.54±3.47	0.316
FVC (% predicted)	96.25±10.36	99.90±8.72	0.529
FEV ₁ (% predicted)	101.19±11.37	102.50±8.17	0.679
FEV ₁ /FVC (% predicted)	105.81±5.86	105.80±7.00	0.966

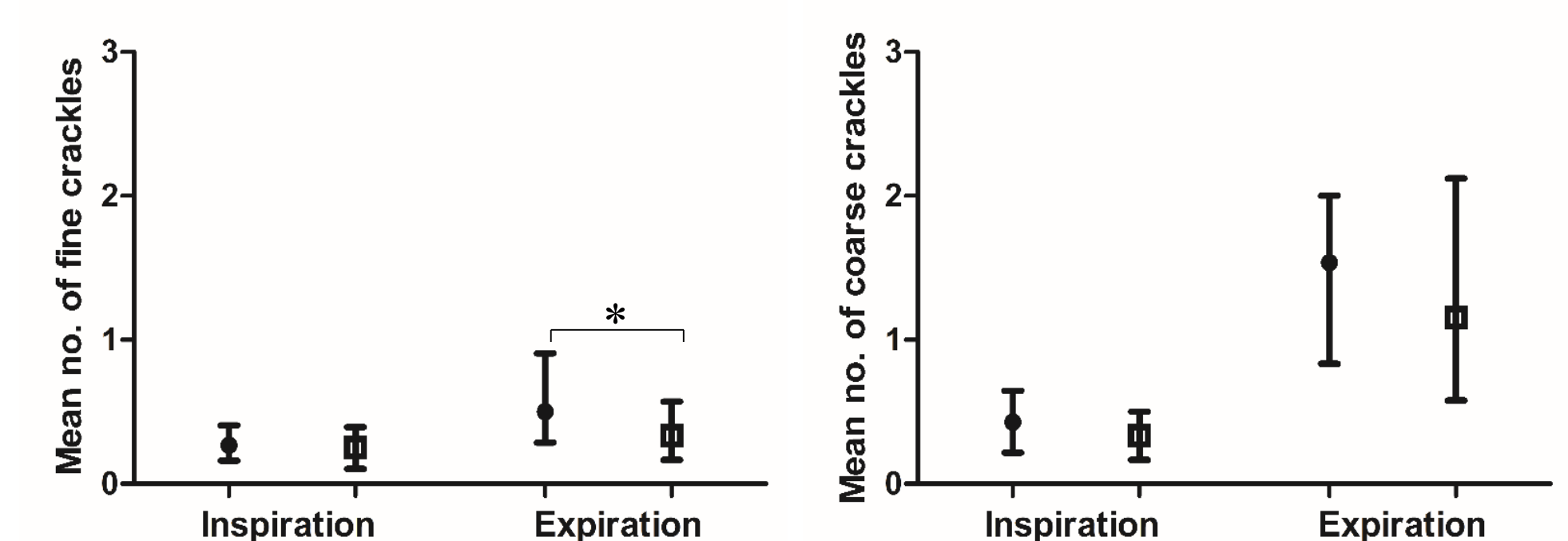
Values are shown as mean ± standard deviation unless otherwise indicated; M, median; IQR, interquartile range; BMI, body mass index; FVC, forced vital capacity; FEV₁, forced expiratory volume in one second.



Graph 1. Mean number of fine and coarse crackles at anterior region.



Graph 2. Mean number of fine and coarse crackles at lateral region.



Graph 3. Mean number of fine and coarse crackles at posterior region.

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