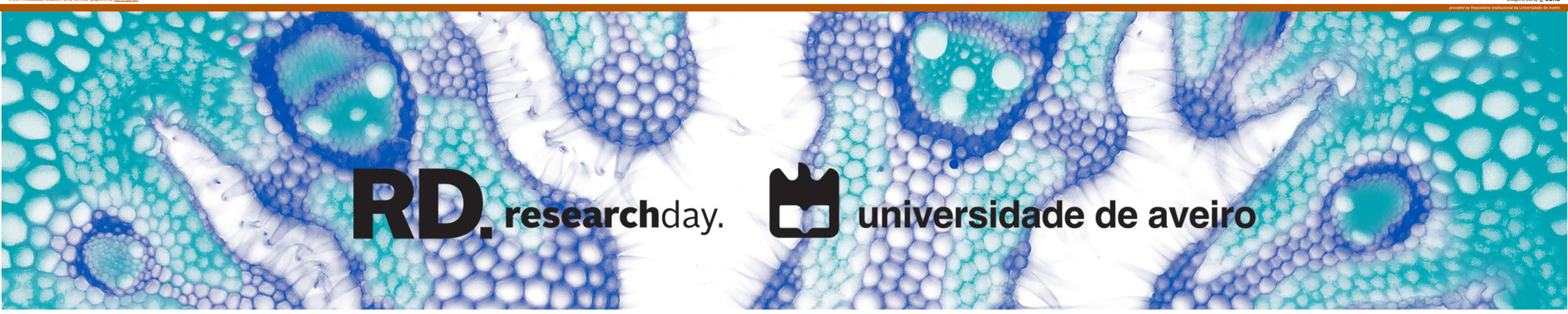

sciences

Validity and reliability of adventitious computerised respiratory sounds in COPD

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Abstract

Computerised adventitious respiratory sounds have been indicated as a promising outcome measure to monitor small changes in lung function of patients with chronic obstructive pulmonary disease (COPD). Nevertheless, before a measure can be used in clinical practice its measurement properties (e.g., reliability and validity) should be tested. Results showed that adventitious respiratory sounds, specially number of crackles, when recorded in the inspiratory phase have excellent reliability and moderate validity to assess lung function in patients with COPD. Thus, crackles might be a promising measure to monitor lung function in patients with COPD.

Background

Respiratory sounds are the outcome most directly related to the movement of air within the tracheobronchial tree.[1] Thus, changes in their characteristics, namely presence of adventitious respiratory sounds (ARS) in computerised auscultation, have been indicated as promising outcome measure to monitor small changes in lung function of patients with chronic respiratory diseases. Nevertheless, before a measure can be used in a given population, its measurement properties should be tested.
The within-day reliability of ARS was found to be excellent with no systematic bias in stable patients with chronic obstructive pulmonary disease (COPD).[2] However, according to our best knowledge, between-day reliability and validity of respiratory sounds have never been assessed in patients with COPD. This study aimed to assess the between-day reliability and validity of ARS to monitor lung function in stable patients with COPD.

Methods

Design & Participants: A cross-sectional study with outpatients with stable COPD recruited from a Central Hospital was conducted.

Mesures: Socio-demographic (age, gender) data were first collected. Then respiratory sounds were recorded simultaneously at posterior right/left chest using air-coupled electret microphones (Figure 1). Finally, lung function [forced expiratory volume in 1 second – absolute (FEV_1) and percentage predicted ($FEV_1pp_)$] was recorded with a spirometer.

Respiratory sounds recordings were also repeated five to seven days after the first data collection, provided that the patient was stable in this interval (i.e., symptoms and medication remained unchanged).

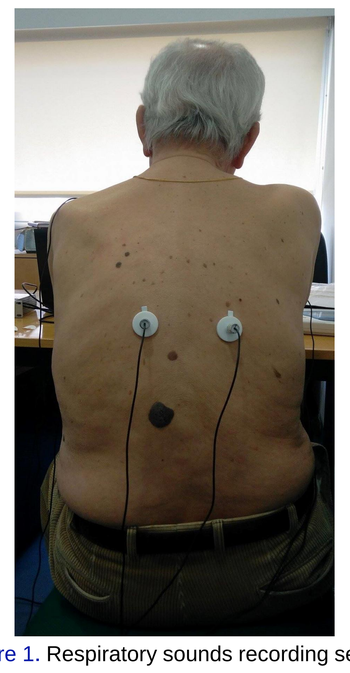

Figure 1. Respiratory sounds recording set up.

Statistics: ARS (i.e., number of crackles and wheeze occupation rate) were processed per respiratory phase (inspiration and expiration) using validated algorithms[3, 4]. Descriptive statistics were used to describe the sample. Between-days relative and absolute reliability were calculated using the intraclass correlation coefficient ($ICC_{1,2}$) and Bland and Altman plots, respectively. Construct validity, against spirometry, was explored with the Spearman's rank correlation coefficient.

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Results

Fifty participants [15 male, 67.26±9.31yrs, FEV_1 1.24±0.53, FEV_1pp 49.52±19.67%) completed the two data collections.
Relative between-days reliability was moderate to excellent for inspiratory ARS and moderate to poor for expiratory ARS (Table 1).

Table 1. Between-day reliability of inspiratory/expiratory number of crackles and wheeze occupation rate per respiratory phase.

	Inspiration		Expiration	
	No. crackles	**%wheezes**	**No. crackles**	**%wheezes**
PR (n=44)	0.790	0.565	0.421	-0,005
	[0.618-0.885]	[0.207-0.762]	[-0.054-0.682]	[-0.847-0.454]
PL (n=42)	0.741	0.481	0.248	0.068
	[0.521-0.859]	[0.040-0.720]	[-0.387-0.593]	[-0.725-0.593]

Legend: PR – Posterior right chest; PL – Posterior left chest.

Good absolute between-days reliability was found in the Bland and Altman plots (Figure 2).

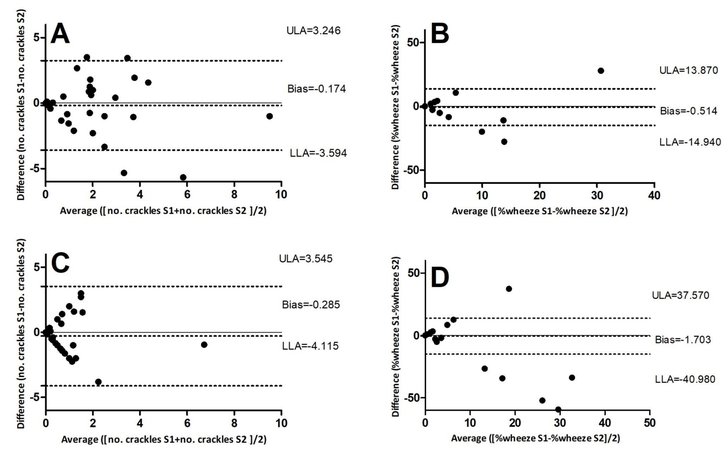

Figure 2. Bland-Altman plots of data collection 1 (S1) and 2 (S2). Inspiratory (A, B) and expiratory (C, D) number of crackles (A, C) and wheeze occupation rate (B, D) at posterior right chest. Solid lines represent the zero value dashed lines show the associated bias and 95% upper (ULA) and lower (LLA) limits of agreement.

Significant negative and moderate correlations were found between inspiratory number of crackles (r_s=-0.302; p=0.037) and wheeze occupation rate (r_s=-0.304; p=0.036) at posterior right chest with FEV_1 (L). Significant negative and moderate correlations were found between inspiratory number of crackles both at posterior right (r_s=-0.443; p=0.002) and left (r_s=-0.286; p=0.049) chest with FEV_1pp. No correlations were found at any chest location and ARS during expiration.

Conclusions

Adventitious respiratory sounds, specially number of crackles, when recorded in the inspiratory phase, show excellent reliability and moderate validity to assess lung function in patients with COPD. Thus, crackles might be a promising measure to monitor lung function in patients with COPD.

References

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