The Identification of Restrictive Lung Disease in Taconite Miners

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BACKGROUND

Estimating disease rates within populations exposed to mining dusts typically involves the use of chest x-ray and lung function testing, usually in the form of screening spirometry. Although widely used, both of these tests have inherent limitations. In this study, results of the clinical application of spirometry are described along with diffusing capacity (DLCO) and alveolar volume (VA) testing in an attempt to identify the prevalence of restrictive lung disease in an exposed population of miners. The combination of these tests was used in the same participants to compare and contrast findings and to obtain additional insights into the prevalence of restrictive lung disease in this population.

OBJECTIVE

This study reports the impact of applying current guidelines for spirometry on the classification of lung disease patterns and compares the estimation of lung restriction using spirometry, alveolar volume (VA) and diffusing capacity (DLCO).

DESIGN AND METHODS

The pulmonary function results of 1,150 current and former taconite industry workers were obtained. All measurements followed the current American Thoracic Society (ATS) guidelines for spirometry, VA and DLCO measurements. Subjects were categorized by the degree to which their test results met acceptability criteria for spirometry. A subject was considered to have an obstructive pattern if his or her FEV_1/FVC ratio was below the lower limit of normal (LLN). A restrictive spirometric pattern was identified if the FEV_1/FVC ratio was normal and FVC value was below the LLN. The LLN was also used as a cut-off point for alveolar volume (VA) and DLCO estimations.

RESULTS

Table 1: Different categories of tests based on meeting ATS guidelines on acceptability and repeatability of spirometric evaluations.			
Participant Group	Category	Frequency	Percent
One acceptable read only	1	35	3
Two acceptable, repeatable reads only	2	49	4.3
Two acceptable, not repeatable	3	33	2.9
Two highest acceptable not repeatable	4	42	3.6
No plateau end-point reached	5	407	35.4
No acceptable read	6	6	0.5
Not repeatable (3 acceptable reads)	7	31	2.7
Meets ATS criteria	8	547	47.6
Total		1150	100

Table 2: Prevalence estimates of lung function patterns in different groups								
	Group 1		Group 2		Group 3		Group 4	
N	1150		603		547		1045	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Spirometric obstruction*	17.4	15.3 - 19.7	28.4	24.9 - 32.1	5.3	3.7 - 7.5	18.1	15.9 - 20.5
Spirometric restriction[†]	4.4	3.3 - 5.7	2.7	1.6 - 4.3	6.2	4.5 - 8.6	4	3.0 - 5.4
Mixed disease**	3	2.1 - 4.1	4.5	3.1 - 6.4	1.3	0.6 - 2.6	3.1	2.2 - 4.3
All spirometric restriction[‡]	7.3	5.9 - 9.0	7.1	5.3 - 9.5	7.5	5.6 - 10.0	7.1	5.7 - 8.8
VA restriction[1]	7	5.7 - 8.7	5.6	4.1 - 7.8	8.6	6.5 - 11.2	6.8	5.4 - 8.5
DLCO restriction[2]	9.9	8.3 - 11.8	8.8	6.8 - 11.3	11.2	8.8 - 14.1	10.1	8.4 - 12.0
Spirometry & VA[3]	2.7	1.9 - 3.8	1.7	0.9 - 3.0	3.8	2.5 - 5.8	2.5	1.7 - 3.6
Spirometry & DLCO[4]	1.4	0.9 - 2.3	0.6	0.3 - 1.7	2.2	1.3 - 3.8	1.3	0.8 - 2.2
VA & DLCO[5]	2.9	2.1 - 4.0	1.5	0.8 - 2.8	4.4	3.0 - 6.5	3	2.1 - 4.2
Spirometry & VA & DLCO[6]	1.2	0.7 - 2.0	0.5	0.2 - 1.5	2	1.1 - 3.6	1.2	0.7 - 2.0
Spirometry Or VA[7]	8.7	7.2 - 10.5	6.6	4.9 - 8.9	11	8.6 - 13.9	8.3	6.8 - 10.2
VA Or DLCO[8]	14.1	12.2 - 16.2	12.9	10.5 - 15.8	15.4	12.6 - 18.6	13.9	11.9 - 16.1
Spirometry Or VA Or DLCO[9]	15.6	13.6 - 17.8	13.8	11.2 - 16.7	17.6	14.6 - 21.0	15.2	13.2 - 17.5

All values are numbers; proportion percent (95% confidence intervals) of prevalence of lung function patterns in each population group.
Group 1– All workers surveyed without exclusion based on ATS criteria for spirometry.
Group 2– All workers that potentially did not meet ATS criteria for acceptable spirometric assessment.
Group 3– Workers that met ATS criteria for acceptable spirometric assessment.
Group 4–Spirometric assessments of quality ≥"B" (Cat 2, 4, 8) & repeatable tests (Cat 5) not meeting end-of-test (EOT) criteria.

RESULTS (contd.)

Only 547 (47.6%) achieved the ATS acceptability criteria for spirometry. Spirometric testing in the total group (N=1,150) showed 17.4% with an obstructive pattern, while 4.4% had restrictive pattern. In those who met the strictest criteria (N=547), only 5.3% had obstruction and 6.2% restriction. A mixed pattern was identified in 3.0% (N=35) of the entire group & only 1.3% (N=7) of those who met the strictest criteria. Prevalence estimates of restrictive lung disease (RLD) using a combination of available tests ranged from 0.5% in Group 2 using the '&' classification and all the tests to 17.6% in Group 3 using the 'Or' classification for all the tests (after excluding obstruction). BMI was significantly related to spirometric restriction in all groups (p < 0.0001) and accounted for about 9% of variation in FVC. DLCO and VA showed larger estimates for reduced FVC (restriction).

CONCLUSION

Estimates of restriction among this population of miners varied by type of test, number of tests used and groups by acceptability criteria. Combining spirometry with other tests provided a range for restriction with narrowed estimates. Strict adherence to inclusion/exclusion criteria in this population was seen to affect estimates by causing exclusions of potentially sicker, older and possibly more exposed individuals in this population at risk for dust exposure. Restriction was significantly related to obesity, measured using BMI, in all groups of acceptability criteria. These factors are important to consider in the use and interpretation of pulmonary function tests when they are used for physiologic screening assessment in dust-exposed populations.