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Validation of respiratory questionnaire for lung function assessment among an occupational group of textile workers in Pakistan.

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ORIGINAL ARTICLE

Validation of respiratory questionnaire for lung function assessment among an occupational group of textile workers in Pakistan

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Abstract

Objective: To determine the association of spirometric lung pattern with respiratory symptoms and to validate the American Thoracic Society respiratory questionnaire for lung function assessment among textile workers.

Methods: This cross-sectional survey was conducted from August to December 2009 among adult textile workers of Karachi. Data was collected through the American Thoracic Society Division of Lung Disease respiratory questionnaire and the lung function was assessed by using a spirometer. Results of three acceptable readings of spirogram were recorded and the best of the three readings was used for analysis. SPSS 19 was used for data analysis.

Results: There were 372 participants in the study with an overall mean age of 27±8.5 years.In linear regression analysis, forced expiratory volume in one second for workers who had chronic cough was -829.1 (confidence interval: -1273.1, -385.2), chronic wheeze -168.8 (confidence interval: -319.3, -18.2) and shortness of breath grade 2 -215.6 (confidence interval: -387.8, -43.4). In logistic regression model, after adjusting for covariates, odds of reduced percentage predicted forced expiratory volume in one second for workers who had chronic cough was 3.09 (confidence interval: 1.26, 7.56), chronic wheeze 1.98 (confidence interval: 1.05, 3.71) and shortness of breath grade 2 2.07 (confidence interval: 1.05, 4.07), while odds of reduced percentage predicted forced vital capacity for shortness of breath grade 2 was 2.35 (confidence interval: 1.05, 5.21). In logistic regression model 2, for assessing the effect of different combinations of chronic respiratory symptoms, the odds of reduced percentage predicted forced expiratory volume in one second for the combination of cough and wheeze was 2.08 (confidence interval: 1.05, 4.10), cough and shortness of breath grade 2 2.47 (confidence interval: 1.18, 5.18), phlegm and shortness of breath grade 2 2.59 (confidence interval: 1.23, 5.43), cough, wheeze and shortness of breath grade 2 4.64 (confidence interval: 1.97, 10.93)and cough, phlegm, wheeze and shortness of breath grade 2 4.18 (confidence interval: 1.68, 10.37).

Conclusion: A combination of chronic respiratory symptoms was best associated with decrements in lung function.

Keywords: ATS, American Thoracic Society, Respiratory questionnaire, Respiratory symptoms, Spirometry, Validation, Textile industry. (JPMA 67: 239; 2017)

Introduction

The textile industry is associated with the processing of cotton, where exposure to cotton dust may lead to development of obstructive respiratory conditions among textile workers, including Chronic Obstructive Pulmonary Disease (COPD), byssinosis, pulmonary tuberculosis and occupational asthma.[1-3] Studies from both low and high income countries have reported respiratory illness and symptoms among textile workers which profoundly affect the quality of life.[1,3-5]

Spirometry is an essential tool for health surveillance of workers in order to diagnose impaired lung function.[6] Studies report that lack of equipment, training and screening tools under diagnosis of the respiratory conditions among industrial workers is a major problem.[7]

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However, a validated questionnaire for respiratory symptoms can improve the efficiency of diagnosis in occupational settings where spirometry is difficult. A number of respiratory questionnaires have been developed and used in occupational settings including American Thoracic Society Division of Lung Disease questionnaire (ATS-DLD-78A), British Medical Research Council respiratory questionnaire (MRC-Q) and European Respiratory Health Survey (ERHS).[8-10] Several studies conducted among textile workers in high as well as low and middle income countries, including Pakistan, have used the ATS-DLD-78A questionnaire and it has been translated into local languages to assess the respiratory symptoms, but there is little data on validation of this questionnaire among the occupational group of textile workers.[4,10]

Pakistan is ranked as the fourth-largest producer of cotton in the world and it has the third-largest spinning capacity in Asia while it contributes 5% to the global spinning capacity.[11,12] Therefore, the textile industry plays a significant role in the national economy and also provides employment to thousands of workers across the country. Occupational health is a neglected area of the health system in Pakistan; there is a general dearth of resources and lack of spirometry equipment and expertise in primary health care as well as occupational settings.[4,7] Lack of data results in unavailability of validated research tools, particularly for the screening of respiratory illness and symptoms among industrial workers. Therefore, there is a dire need to identify locally validated standard respiratory illness screening tool for occupational groups. This study was planned to determine the association of spirometric lung pattern with respiratory symptoms and to validate the ATS-DLD-78A respiratory questionnaire for lung function assessment among an occupational group of textile workers.

Subjects and Methods

This cross-sectional study was conducted from August to December 2009 among adult male textile workers of Karachi, which is the largest city of Pakistan with an estimated population, according to unofficial figures, of about 23.5 million.[13] The diverse population of the city includes people from different ethnic groups from across the country.[14] Being the financial hub of the country, Karachi has approximately 4,500 industrial units in the formal sector.[15]

The participants were purposively recruited from the spinning and weaving sections of 15 textile mills. Subjects working for at least 1 year, and aged 18 years or more were included. Workers who were unable to perform spirometry, and the administrative staff in the mills were excluded. Approximately half of the samples were selected from the spinning, and the other half from the weaving section. Workers were recruited into the study through attendance register maintained at the mills.

Since this study was based on secondary data analysis,[4] we did post-hoc sample size calculations using Open-Epi version 3.01 (Atlanta, Georgia).[16] For determining the association of spirometric lung pattern, the sample size was calculated by using odds ratio (OR) of 2.44 (cough), 2.35 (phlegm), 6.33 (wheeze) and 2.35 (shortness of breath),[17] using 95% confidence interval (CI) and 80% power. For determining the respiratory symptoms prevalence among workers, anticipated proportions of 17.5% (cough), 19% (phlegm), 14% (wheeze), 10.5% (shortness of breath) and 35% (chest tightness), were used,[17] using 95% CI and absolute precision of 5%.

Using 95% CI with desired precision (d) of 0.01, the sensitivity and specificity of respiratory symptoms [(cough) 14.8% and 94.8%, (phlegm) 14.8% and 91.8%, (wheeze) 12.9% and 91.1% and (shortness of breath) 11.1% and 89.6%][17] was calculated using a sample size calculator for sensitivity and specificity by Dr Lin Naing (Mohd. Ayub Sadiq, School of Dental Sciences, Universiti Sains Malaysia).[18] "Based on the abovecalculations the maximum required sample size was 290."

The ATS-DLD-78A questionnaire was used to assess the respiratory symptoms. Various sections of the questionnaire include assessment of frequent cough (presence of cough on most days for 3 consecutive months or more during the year), chronic cough (presence of cough for 3 consecutive months for at least 2 consecutive years), frequent phlegm (production of phlegm on most days of month, for 3 consecutive months or more in a year), chronic phlegm (production of phlegm for 3 consecutive months for at least 2 consecutive years), frequent wheeze (whistling sound on expiration present for less than 2 years), chronic wheeze (whistling sound on expiration present for at least 2 years), shortness of breath grade 1 (shortness of breath, when hurrying on the level or walking up a slight hill) and shortness of breath grade 2 (having to walk slower than people of the same age on the level because of breathlessness or having to stop for breathing when walking at own pace on the level). Questions related to chest tightness ever (chest ever feeling tight and/or breathing becoming difficult) and chest tightness apart from cold (chest feeling tight and/or breathing becoming difficult occasionally apart from during cold) were added from the respiratory questionnaire of the World Health Organisation's (WHO) Technical Report Series 684.[19]

A portable spirometer (Vitalograph New Alpha 6000; Vitalograph Ltd., Buckingham, England) was used for performing lung function measurements in accordance with the ATS guidelines.[17] The predicted values of forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and their ratio (FEV1/FVC) were recorded in ml and percentages. Percent predicted values were based on the standardised equations of the European Respiratory Society 1993, with a correction factor of 0.9 for Asian population.[20] For normal lung function tests, predicted percentage of > 80% for FVC and FEV1 and FEV1/FVC ratio of >0.7 were considered cut-off values.[21] Obstructive lung function was defined as having FEV1<80% of predicted and FEV1/ FVC <0.7% and restrictive lung function was defined as having FVC <80% of predicted and FEV1/FVC >0.7%.[21] Spirometry was conducted in standing position and ATS repeatability criteria were used for quality assessment of the spirometrymanoeuvre.

Data was entered into Epidata 3.1 and analysed using SPSS19. Logistic regression analysis was performed to determine crude and adjusted odds ratio of frequent and chronic respiratory symptoms. The model was adjusted for age, height, weight, education, smoking status, ethnicity, socio-economic status (SES), duration of work and section of mills. Linear regression analysis was performed separately for FEV1, FVC and FEV1/FVC ratio in order to determine the association of percentage predicted lung volumes with respiratory symptoms. Sensitivity and specificity of the ATS respiratory questionnaire along with predictive values was also calculated for abnormal and obstructive lung patterns separately. Receiver operating curves (ROC) were also plotted by using Med-calc software.[19,22] We used combined chronic respiratory symptoms (cough + phlegm + wheeze + shortness of breath grade 2) as a diagnostic variable with percentage predicted lung volumes as a test variable to assess the sensitivity and specificity.

Approval was obtained from the ethics review committee of the Aga Khan University, Karachi. Verbal and written informed consent was obtained from all the participants. Privacy was maintained at the time of data collection and strict confidentiality of participants' data was maintained.

Results

There were 372 participants in the study. The overall mean age was 27±8.5 years. A general trend of decrements in lung function was observed among participants who had chronic respiratory symptoms (Figure-1).

In linear regression analysis, FEV1 (ml) for workers who had chronic cough was adj β: -829.1, CI: -1273.1, -385.2, chronic wheeze (adj β: -168.8, CI: -319.3, -18.2) and shortness of breath grade 2 (adj β: - 215.6, CI: -387.8, -43.4). FVC (ml) for shortness of breath grade 2 was adj β: - 259.3, CI: -454.4, -64.3. FEV1/FVC ratio for chronic cough was (adj β: -41.0, CI:-70.7, -11.4), frequent wheeze (adj β: -31.2, CI: -54.6, -7.7) and chronic wheeze -46.3, CI:-76.3, -16.3) (Table-1).

In logistic regression model, after adjusting for covariates, odds of reduced percentage predicted FEV1 for workers who had chronic cough was aOR: 3.09, CI: 1.26, 7.56, chronic wheeze (aOR 1.98, CI: 1.05, 3.71) and shortness of breath grade 2 (aOR: 2.07, CI: 1.05, 4.07), while odds of reduced

Table-1: Adjusted linear regression analysis of respiratory symptoms with absolute lung volume among textile workers. n=372.

Symptoms	FVC (ml)[A]		FEV1 (ml)[B]		FEV1/FVC ratio	
	Crude β (95% CI)	Adj β (95% CI)	Crude β (95% CI)	Adj β (95% CI)	Crude β (95% CI)	Adj β (95% CI)
Cough						
Frequent±[C]	177.8 (-34.4, 390.1)	119.4 (-77.0, 315.9)	120.1 (-70.6, 310.9)	49.4 (-118.8, 217.6)	-4.1 (-28.7, 20.5)	-1.9 (-31.6, 27.6)
Chronic±±[D]	-175 (-475.8, 125.2)	-190.2 (-465.8, 85.3)	-260.6 (-527.3, 5.9)	-829.1 (-1273.1, -385.2)	-31.6 (-65.8, 2.4)	-41.0 (-70.7, -11.4)
Phlegm						
Frequent±	-34.7 (-214.3, 144.9)	-45.2 (-210.0,119.5)	-23.4 (-184.6, 137.6)	-39.8 (-181.6, 102.0)	2.7 (-18.0, 23.5)	-11.3 (-37.1, 14.5)
Chronic±±	119.1 (-118.6, 356.9)	136.8 (-84.8, 358.6)	-65.3 (-281.2, 150.4)	-85.8 (-371.3, 199.6)	-43.0 (-70.8, -15.3)	-21.1 (-55.6, 13.4)
Wheeze						
Frequent±[E]	25.1 (-137.0, 187.3)	-13.9 (-165.9, 138.0)	-20.7 (-166.2, 124.7)	-26.4 (-155.7, 102.9)	-10.9 (-29.6, 7.8)	-31.2 (-54.6, -7.7)
Chronic±±	-36.8 (-228.1, 154.4)	-9.2 (-188.6, 170.1)	-209.9 (-378.2, -41.7)	-168.8 (-319.3, -18.2)	-47.5 (-69.8, -25.2)	-46.3 (-76.3, -16.3)
Shortness of breath						
grade 1±[F]	-125.0 (-283.7, 33.5)	-112.9 (-261.2, 35.3)	-167.3 (-309.0, -25.5)	-104.2 (-231.4, 22.8)	-16.7 (-35.0, 1.6)	1.7 (-22.6, 26.1)
grade 2±±[G]	-236.0 (-442.3, -39.7)	- 259.3(-454.4, -64.3)	-277.4 (-464.9, -89.9)	- 215.6 (-387.8, -43.4)	-25.4 (-49.1, -1.7)	-15.4 (-48.9, 18.0)
Chest tightness						
Ever±[H]	178.9(11.4, 346.3)	171.7 (15.6, 327.7)	57.0 (-93.9, 208.0)	74.0 (-59.0, 207.2)	-18.1 (-37.4, 1.2)	-21.5 (-47.5, 4.4)
Apart from cold±±[I]	153.2 (-53.1, 359.7)	153.1 (-39.5, 345.9)	62.4 (-124.7, 249.6)	82.4 (-83.5, 248.3)	-13.0 (-36.2, 10.2)	-21.8 (-51.7, 8.0)

Adjusted for; age, height, weight, duration of work, dust exposure, section of mill, socio-economic status and smoking

± Variables for frequent symptoms were taken as binary, Yes =1/ and No =0 (reference category)

±±Variables for chronic symptoms were taken as binary, Yes =1/ and No =0 (reference category)

[A] FVC= forced vital capacity

[B] FEV1= forced expiratory volume in 1 second

[C] Question asked: do you usually cough/bring up phlegm 5 or more days of the week?

[D] Chronic applies for symptoms present for more than 2 years.

[E] Question asked: does your chest ever sound wheezy or whistling?

[F] Question asked: are you troubled by shortness of breath when hurrying on level ground, or walking up a slight hill?

[G] Question asked: do you have to walk slower than people of your age, on level ground, because of breathlessness?

[H] Question asked: does your chest ever feel tight and/or your breathing becomes difficult?

[I] Question asked: does your chest feel tight and/or your breathing becomes difficult occasionally apart from cold

CI: Confidence interval.

Table-2: Adjusted logistic regression analysis of respiratory symptoms with impaired percentage predicted lung volume among textile workers (n=372).

Symptoms	% predicted FVC A		% predicted FEV1 B		% predicted FEV1/FVC ratio C	
	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)
Cough						
Frequent±	1.23 (0.51, 2.95)	1.38 (0.57, 3.37)	1.13 (0.56, 2.28)	1.28 (0.61, 2.66)	0.63 (0.18, 2.18)	0.61 (0.19, 2.61)
Chronic±±	1.82 (0.58, 5.64)	1.78 (0.56, 5.64)	2.65 (1.13, 6.21)	3.09 (1.26, 7.56)	2.70 (0.84, 8.63)	3.93 (1.12, 13.75)
Phlegm						
Frequent±	1.06 (0.49, 2.30)	1.12 (0.51, 2.46)	0.86 (0.46, 1.59)	0.84 (0.44, 1.61)	0.81 (0.31, 2.09)	0.80 (0.30, 2.10)
Chronic±±	0.94 (0.31, 2.85)	0.90 (0.29, 2.80)	1.93 (0.94, 3.94)	1.75 (0.83, 3.69)	2.15 (0.80, 5.76)	0.57 (0.19, 1.69)
Wheeze						
Frequent±	0.63 (0.30, 1.34)	0.67 (0.31, 1.44)	1.14 (0.66, 1.95)	1.19 (0.67, 2.12)	2.18 (0.97, 4.89)	0.41 (0.17, 0.99)
Chronic±±	1.03 (0.45, 2.33)	0.76 (0.32, 1.81)	2.09 (1.13, 3.86)	1.98 (1.05, 3.71)	3.49 (1.50, 8.14)	2.59 (1.02, 6.57)
Shortness of breath						
grade 1±±	1.47 (0.74, 2.95)	1.42 (0.69, 2.92)	1.97 (1.14, 3.39)	1.77 (1.00, 3.13)	1.35 (0.61, 3.01)	1.14 (0.48, 2.72)
grade 2±±	2.50 (1.15, 5.41)	2.35 (1.05, 5.21)	2.50 (1.32, 4.74)	2.07 (1.05, 4.07)	1.41 (0.54, 3.69)	1.11 (0.40, 3.03)
Chest tightness						
Ever±	0.74 (0.34, 1.60)	0.67 (0.31, 1.46)	1.27 (0.73, 2.21)	1.09 (0.61, 1.95)	1.06 (0.46, 2.45)	1.00 (0.42, 2.37)
Apart from cold±±	1.10 (0.47, 2.56)	0.89 (0.37, 2.11)	1.38 (0.71, 2.68)	1.12 (0.55, 2.26)	0.82 (0.26, 2.54)	0.70 (0.21, 2.34)

Adjusted for; age, ethnicity, weight, height, smoking, section of mill and duration of work

± Variables for frequent symptoms were taken as binary Yes =1/ and No =0 (reference category)

±±Variables for chronic symptoms were taken as binary Yes =1/ and No =0 (reference category)

A Entered as dichotomous variable >80% (normal)and<80%; B Entered as dichotomous variable >80% (normal)and <80%;

C Entered as dichotomous variable >70 %(normal) and <70%

FVC= forced vital capacity

FEV1= forced expiratory volume in 1 second

CI: Confidence interval.

Table-3: Association of different combinations of chronic respiratory symptoms with impaired lung function among textile workers (n=372).

	% Predicted FVC[A]		% predicted FEV1[B]		% predicted FEV1/FVC[C]	
Chronic symptoms	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Cough + phlegm	0.47	0.17, 2.23	1.66	0.74, 3.69	2.88	0.94, 8.83
Cough + wheeze	0.97	0.41, 2.32	2.08*	1.05, 4.10	1.98	0.73, 5.35
Cough + SOB	2.23	0.94, 5.29	2.47*	1.18, 5.18	1.02	0.31, 3.28
Phlegm + wheeze	0.81	0.32, 2.03	0.63	0.32, 1.25	3.10*	1.13, 8.48
Phlegm + SOB	2.12	0.87, 5.16	2.59*	1.23, 5.43	2.04	0.68, 6.12
Wheeze + SOB	2.61*	1.09, 6.24	0.26*	0.12, 0.56	1.99	0.70, 5.66
Phlegm + Wheeze + SOB	2.23	0.84, 5.89	0.26*	0.11, 0.63	3.52*	1.04, 11.96
Cough + wheeze + SOB	2.37	0.95, 5.94	4.64*	1.97, 10.93	1.52	0.46, 4.95
Cough + phlegm + SOB	1.92	0.75, 4.94	0.37	0.17, 0.81	1.52	0.42, 5.39
Cough + phlegm + wheeze	0.74	0.28, 1.92	1.65	0.81, 3.35	2.64	0.87, 7.95
Cough + phlegm + wheeze+ SOB	2.17	0.80, 5.86	4.18*	1.68, 10.37	1.98	0.51, 7.66

Adjusted for; age, ethnicity, weight, height smoking, section of mill and duration of work

*p<0.05 significant

Variables created for different combinations of symptoms were all taken as binary Yes =1/ and No =0 (reference category)

A Entered as dichotomous variable >80% (normal) and <80%; B Entered as dichotomous variable >80% (normal) and <80%;

C Entered as dichotomous variable >70 %(normal) and <70%

FVC= forced vital capacity

FEV1= forced expiratory volume in 1 second

SOB: shortness of breath

CI: Confidence interval

Table-4: Sensitivity, specificity and predictive values of respiratory symptoms according to abnormal A pattern on spirometric interpretation among textile workers in Karachi (n=372).

Symptoms	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	p-value
Abnormal pattern [A]					
Frequent cough	19.4	84.0	22.5	81.2	0.80
Chronic cough	15.0	93.1	32.1	83.5	0.02*
Frequent phlegm	27.7	73.6	20.2	80.9	0.87
Chronic phlegm	18.3	85.7	22.9	81.3	0.03*
Frequent wheeze	44.4	61.3	21.6	82.1	0.16
Chronic wheeze	38.4	75.4	29.4	82.1	<0.01*
Shortness of breath grade 1	56.9	55.6	23.5	84.3	0.20
Shortness of breath grade 2	53.6	57.8	28.1	80.2	0.17
Chest tight ever	38.8	68.0	22.5	82.2	0.10
Chest tight apart from cold	60.7	44.7	24.2	79.6	0.16
Combined [B]	63	63	17	93	0.02*
Obstructed pattern [C]					
Frequent cough	18	84	11.1	90.6	0.68
Chronic cough	14.2	93.1	17.3	91.5	0.15
Frequent phlegm	25	73.6	9.1	90.2	0.87
Chronic phlegm	23.3	85.7	15.9	90.6	0.19
Frequent wheeze	53.1	61.3	12.7	92.4	0.11
Chronic wheeze	44.8	75.4	17.8	92	0.02*
Shortness of breath grade 1	56.2	55.6	11.9	92.2	0.19
Shortness of breath grade 2	38.8	57.8	11.1	87.5	0.49
Chest tight ever	50	68	14.2	92.7	0.04*
Chest tight apart from cold	50	44.7	13.1	84.3	0.14
Combined chronic symptoms [D]	62	63	14.9	94.3	0.04*

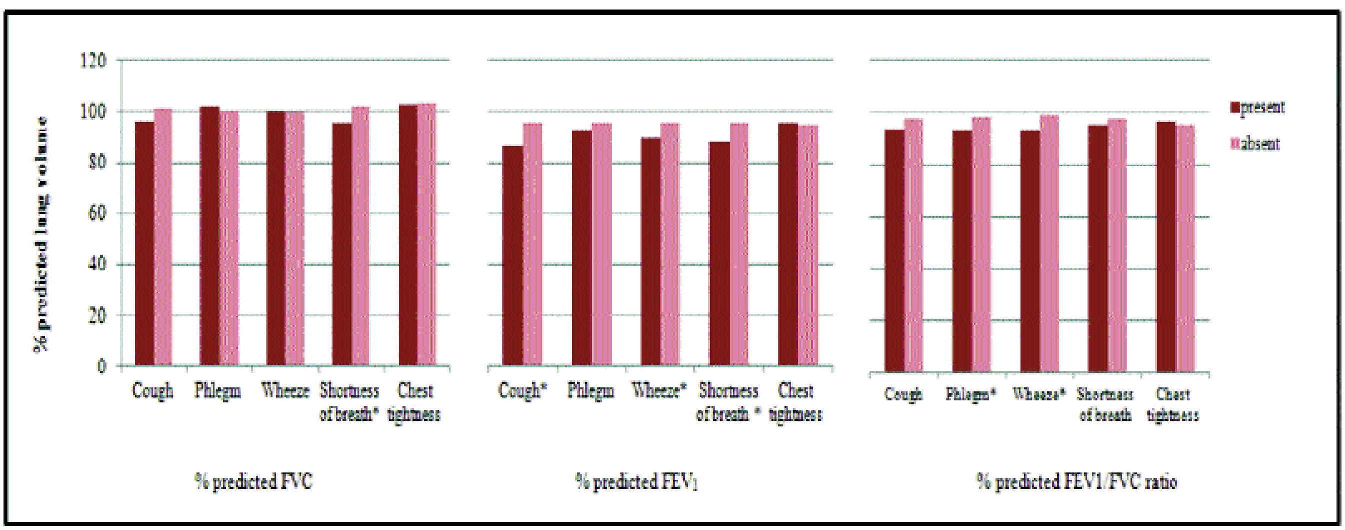
[A] Abnormalspirometry pattern include mild obstruction, moderate obstruction, severe obstruction, mild restriction, moderate restriction, severe restriction and mix obstructed and restricted pattern

[B] Combined chronic symptoms (n=176) = cough+phlegm+wheeze+shortness of breath grade 2

[C] Obstructed spirometry pattern include mild obstruction, moderate obstruction, severe obstruction,

[D] Combine chronic symptoms (n=176) = cough+phlegm+wheeze+shortness of breath grade 2

*p<0.05.



FVC= forced vital capacity
FEV1= forced expiratory volume in 1 second

Figure-1: Comparison of lung function of the study population according to presence or absence of chronic respiratory symptoms (n=372) [*p < 0.05].

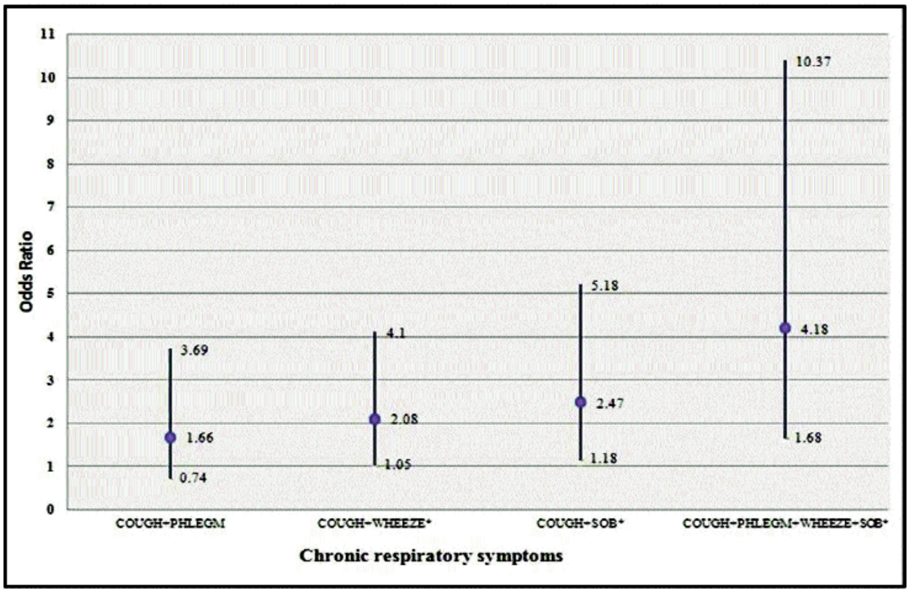


Figure-2: Association of decrease in lung function [% predicted FEV1] with different combinations of chronic respiratory symptoms assessed on ATS; [SOB=shortness of breath grade 2, *p value<0.05].

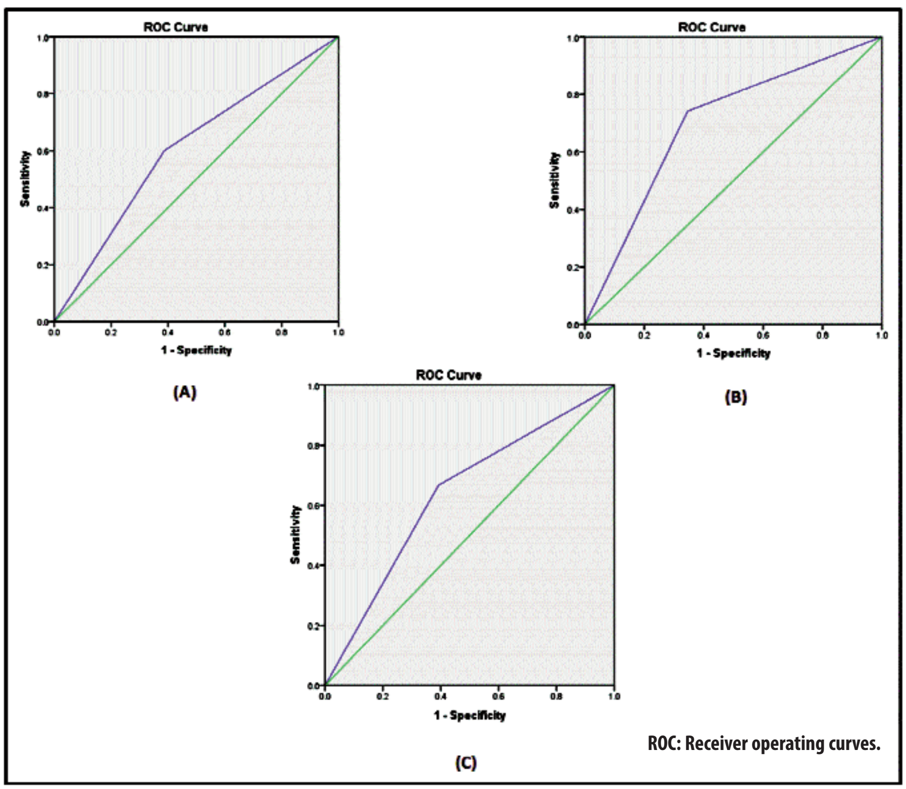


Figure-3: (A) ROC for % predicted FVC with combined respiratory symptoms.
Area under the curve 0.60, Test variable=Chronic cough+ chronic phlegm + chronic wheeze + shortness of breath grade 2
(B)ROC for % predicted FEV1 with combined respiratory symptoms.
Area under the curve 0.69, Test variable=Chronic cough+ chronic phlegm + chronic wheeze + shortness of breath grade 2
(C) ROC for % predicted FEV1/FVC with combined respiratory symptoms.
Area under the curve 0.63, Test variable=Chronic cough+ chronic phlegm + chronic wheeze + shortness of breath grade 2.

percentage predicted FVC for shortness of breath grade 2 was aOR: 2.35, CI: 1.05, 5.21. Odds of reduced percentage predicted FEV1/FVC ratio for chronic cough was aOR: 3.93, CI: 1.12, 13.75 and for chronic wheeze was aOR: 2.59, CI: 1.02, 6.57 (Table-2).

In logistic regression model 2, for assessing the effect of different combinations of chronic respiratory symptoms, the odds of reduced percentage predicted FEV1 for the combination of cough + wheeze was aOR: 2.08 CI: 1.05, 4.10, cough + shortness of breath grade 2 (aOR: 2.47, CI: 1.18, 5.18), phlegm + shortness of breath grade 2 (aOR: 2.59, CI: 1.23, 5.43), cough + wheeze + shortness of breath grade 2 (aOR: 4.64, CI: 1.97, 10.93)and cough + phlegm +wheeze + shortness of breath grade 2 (aOR: 4.18, CI: 1.68, 10.37) (Table-3, Figure-2).

ROCs were plotted for all percentage predicted lung volumes with combined symptoms (cough + phlegm+ wheeze + shortness of breath grade 2) to compare the diagnostic accuracy of the test. Area under the curve for percentagepredicted FEV1, FVC and FEV1/FVC ratio was0.69, 0.60, 0.63, respectively (Figure-3).

Abnormal spirometry pattern included mild, moderate, or severe obstruction, and mild, moderate, or severe restriction as well as mix of obstructive and restrictive patterns. With respect to abnormal and obstructive lung patterns, the specificity was found to be> 80% for frequent cough, chronic cough and chronic phlegm, and > 80% negative predictive values for all the respiratory symptoms. The sensitivity and positive predicted values were found to be low for all the respiratory symptoms (Table-4). The sensitivity of chronic symptoms in relation to obstructive spirometric interpretation was: cough 14.2%, phlegm 23.3%, wheeze 44.8%, shortness of breath grade-2 38.8% and chest tightness apart from cold 50%.Specificity of chronic symptoms in relation to obstructive spirometric interpretation was: cough 93.1%, phlegm 85.7%, wheeze 75.4%, shortness of breath grade-2 57.8 %, and chest tightness apart from cold 44.7%.

Discussion

There are several studies worldwide, which have determined the burden of respiratory illness among textile workers.[1,2,4,10] However, we believe that the current study may be the first one to report the validation of ATS respiratory questionnaire among this occupational group. The findings of the study show that chronic respiratory symptoms including cough, wheeze and shortness of breath are significantly associated with reduced lung function and this trend was found consistently for all lung function indices (FVC, FEV1 and FEV1/FVC).

In our study, significant association was found between chronic respiratory symptoms and decreased lung function. A number of studies conducted on different occupational groups have shown association of selective symptoms with reduced lung function.[3,23] A study conducted among textile workers in the United Kingdom (UK) reported significant decrease in FEV1 in the presence of work-related cough (-8.0%) and chest tightness (-7.3%).[3] A study conducted in Iran reported that frequency of respiratory symptoms in cotton exposed workers was 5 times more than office workers (aOR= 5.03, 95% CI=1.47-17.14). They also found significant decrement in FVC, 86.45±10.89; FEV1, 88.77±11.80; and FEV1/FVC, 80.97±6.52 among textile workers compared to office workers.[24] A study conducted in India reported significant decrease in lung function of workers from the textile industry i.e. FVC 2.36 litres compared to milk factory workers 2.98 litres; and FEV1 2.06 litres compared to 2.63 litres.[25] A 20-year follow-up study found that long-term exposure to cotton dust resulted in chronic loss in FEV1, and the persistent respiratory symptoms in higher proportion among textile workers in Shanghai, China.[26]

We also found a significant association between decreased lung function with combinations of more than one chronic symptom, where lung function decreased with the addition of more than one symptom (cough + phlegm + wheeze + shortness of breath grade 2). The receiver operator curve for all the chronic symptoms i.e. (cough + phlegm + wheeze + shortness of breath grade 2) with lung functions and area under the curve was found to be 0.69 for percentage predicted FEV1, 0.60 for percentage predicted FVC and 0.63 for percentage predicted FEV1/FVC ratio, which shows the fair measure for use of ATS in occupational setting.[27]

This study found low sensitivity and positive predictive values for the questions regarding all frequent and chronic respiratory symptoms with respect to abnormal and obstructive lung patterns, a finding which is consistent with previous studies validated against chronic respiratory symptoms.[17,27] Furthermore, for all the chronic symptoms combined, the sensitivity and specificity were found to be 63%. This finding is similar to the study conducted in rural settings of Sindh, Pakistan where the reported sensitivity of chronic symptoms in relation to obstructive spirometric interpretation was: cough 14.8%; phlegm 14.8%; wheeze 12.9%; and shortness of breath grade-2 11.1%.[17] The specificity of chronic symptoms in relation to obstructive spirometric interpretation was also similar.[17] Furthermore, in that study, for all the chronic symptoms, when combined i.e. (cough + phlegm + wheeze + shortness of breath grade 2), the sensitivity was found to be 22.2% and specificity was 81.4%. The findings in our study illustrate that respiratory symptoms can be good predictors of impaired lung function and the questionnaire (ATS - DLD-78A) can be used as a validated tool to estimate the burden of respiratory symptoms among working population.[17]

This study has a few limitations which need to be considered. It may not be possible to establish a causal association between impaired lung function and the respiratory symptoms since this was a cross-sectional survey. However, the consistent trend of decrement in lung volumes is important and provides basis for further research. We believe that this study significantly adds to the scarcely available evidence regarding ATS respiratory questionnaire validation in textile workers, especially in the low and middle income countries.

In this study, spirometry was used as an objective measure to assess respiratory function and comparison was made with the presence of respiratory symptoms through the questionnaire. Spirometry has an additional advantage of identifying impaired lung function among those who do not have apparent symptoms and it may not be possible to capture such impairment by the use of questionnaire alone.[17] The results of this study may not be generalised to women as we only included men due to very low frequency of women working in selected occupational group. Environmental measurements to see the effect of indoor air pollution on decreased lung function in textile mills could not be done due to financial limitations.

However, despite the limitations, this study highlights several findings which have important public health implications for resource-limited settings, where use of such standardised questionnaires can serve as a cost-saving tool in the diagnosis of respiratory symptoms without need of additional resources.

Conclusion

Chronic respiratory symptoms were significantly associated with decrements in lung function and should be strongly emphasised in clinical or occupational history for assessment of respiratory health. The use of standardised respiratory questionnaires is an effective tool for assessing the burden of respiratory symptoms in occupational setting.

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