ORIGINAL ARTICLE

Low prevalence of asthma among textile workers in Karachi, Pakistan

Sana Tanzil, Asaad Ahmed Nafees

Abstract

Objective: To determine the prevalence of asthma in textile workers through post-bronchodilator spirometry and to compare the differences in prevalence based on different criteria used to assess asthma.

Methods: The cross-sectional study was conducted between July and December 2013 in Karachi, Pakistan, and comprised workers from15 textile mills in the city and its outskirts. Asthma and associated respiratory symptoms were assessed using the American Thoracic Society Division of Lung Diseases Questionnaire, and post-bronchodilator spirometry. SPSS 19 was used for statistical analysis.

Results: Among the 372 workers in the study, asthma was found in 19(5%) as diagnosed on post-bronchodilator spirometry. The prevalence of self-reported and physician-diagnosed asthma was 15(4%) and 8(2%) respectively. Work in the spinning section, age ≥38 years, duration of work ≥10 years in textile industry, history of smoking, and ≥10 pack years of smoking were found to be important predictors of asthma.

Conclusion: Textile industry workers had low prevalence of asthma, assessed through post-bronchodilator spirometry, compared to estimates for the general population. This could possibly be due to some protective effect of endotoxin exposure although further evaluation with better exposure assessment is warranted.

Keywords: Asthma, Cotton dust, Gram-negative bacterial endotoxin, Textile workers, Pakistan. (JPMA 65: 869; 2015)

Introduction

Asthma is a global public health concern and recent estimates from the World Health Survey (WHS) conducted by the World Health Organisation (WHO) show an overall global asthma prevalence of 4.3%.[1] The global burden of asthma is reported to be higher among high-income countries compared to low-income countries.[1] A systematic review conducted between June 1999 and December 2007 reported that 16.3% of all adult-onset asthma cases were induced by occupational exposures. This review included six longitudinal studies, three case-control studies, eight cross-sectional analyses from seven general population-based samples and three asthma case reports from insurance-based data, and represents population from 19 different countries across the world. Cases were defined as physician-diagnosed asthma related to workplace exposures occurring at or beyond the age of 15 years.[1] Various occupations have been linked with an increased risk of asthma due to specific work-related exposures such as laboratory workers (OR: 1.68), wood workers(OR: 1.11), electricity workers (OR: 1.75) and textile workers (OR: 0.60 to1.47).[2]

Textile industry is known for occupational health hazards resulting in occupational respiratory diseases such as byssinosis, bronchial asthma and allergies among workers.[3] Textile workers are exposed to higher levels of cotton dust in sections involving initial processing of raw cotton. Therefore, blowing, carding and spinning sections, where bales are opened and raw cotton is processed to form thread, involve relatively higher dust exposure compared to weaving and finishing sections where fabric is formed from thread and stitching or packaging is done.[4] Asthma has also been reported among textile workers by several studies especially from the developing countries like India, Ethiopia and Pakistan.[5-7] Recent evidence suggests a dose-response relationship between gram-negative bacterial endotoxin found in cotton dust and lung function impairment in German textile workers.[8] However, other studies report a protective effect of endotoxin exposure on the onset of asthma. This protective effect of endotoxin exposure is consistent with the 'hygiene hypothesis'; explaining association of other microbial exposures or infections with a lower incidence of atopic disease.[9] Nevertheless, the exact burden of asthma among textile workers assessed through post-bronchodilator spirometry remains unknown. Identification of the burden and early detection of asthma may contribute towards better health outcomes among workers who are at risk.

Previous studies conducted in the UK (1960) and the US(1970) have used symptoms-based respiratory questionnaires to determine the prevalence of asthma and other respiratory illnesses.[10] The most frequently assessed respiratory symptoms include wheeze, chest

Department of Community Health Sciences, Aga Khan University, Karachi.
Correspondence: Asaad Ahmed Nafees. Email: asaad.nafees@aku.edu

tightness, shortness of breath and cough.[10,11] Several questionnaires are available which assess asthma, including British Medical Research Council Questionnaire, American Thoracic Society Division of Lung Diseases Questionnaire (ATS-DLD-78A) and Asthma Screening Questionnaire.[10,11]

Textile industry is the leading sector of Pakistan with regard to production, export and labour force employment and contributes 8.5% to the national GDP.[12] Karachi is the financial hub of the country and contributes a considerable amount to national economy, hosting major industries of the country, including the textile industry.[13] The city is estimated to have a population of more than 23 million comprising various ethnic and linguistic groups. However, Urdu is the most popular language, spoken by around 49% of the population.[13] A recent survey comprising 372 textile workers from Karachi found prevalence of asthma to be 4% (n=15) but this estimate was only questionnaire-based and did not involve lung function test.[6]

Estimation of true asthma prevalence among textile workers will not only measure the actual burden, but will also facilitate the comparison of these estimates with the general population and textile workers from other countries. The difference in estimates may help in developing hypothesis for the role of possible environmental and socio-demographic factors responsible for asthma. The current study was conducted to determine the prevalence of asthma among textile workers through post-bronchodilator spirometry and to compare the differences in prevalence based on different criteria used to assess asthma.

Subjects and Methods

The study, conducted from July to December 2013, was a secondary analysis of data collected through a cross-sectional survey between August and December 2009.[6] According to estimates available from the Department of Labour, Government of Sindh (2009), there are 794 registered textile units in five main industrial areas in Karachi where textile mills are located, and a total of 15 textile mills, selected through convenience sampling, were included in the survey. This study focussed on the blowing, carding, spinning and weaving sections, as higher dust levels were expected in these sections. Adult male textile workers who were working in textile mills for at least 12 months were recruited. All workers present at a particular mill during the visit of the study team and who met the inclusion criteria were recruited.[6]

Information regarding self-reported asthma, physician-diagnosed asthma and frequent or chronic respiratory symptoms was collected through the ATS-DLD-78A questionnaire.[14] Information was also collected regarding socio-demographic characteristics and major occupational exposures including section of mill, history of dusty job as well as duration of work in the textile industry and family history of asthma. Questionnaire was pre-tested before using it in the study.

Lung function measurements were conducted by a trained physician through Vitalograph New Alpha 6000 (Vitalograph Ltd., Buckingham, England) spirometer. Assessment procedure was explained in detail to all the participants. Spirometry indices recorded included Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC) and FEV1/FVC ratio, which were recorded in millilitres as well as percentage predicted values. All the workers identified with an obstructive pattern on spirometry (FEV1/FVC <0.7, FEV1< 80% predicted) underwent a post-bronchodilator spirometry and were assessed for reversibility in obstruction according to Global Initiative for Asthma (GINA) guidelines.[15] GINA guidelines provide a comprehensive approach and are considered as the gold standard for asthma diagnosis.[16] Therefore, these guidelines were followed to make the estimates comparable with international literature and a change in FEV1 of ≥200 ml or ≥12% following post-bronchodilator therapy was considered asthma.[15]

The study was approved by the Ethics Review Committee (ERC) of the Aga Khan University, Karachi.

Data were entered on Epidata 3.1 and analysed using SPSS 19. Frequencies were calculated for respiratory symptoms and lung function related categorical variables, including lung function patterns, physician-diagnosed asthma and as well as asthma diagnosed on post-bronchodilator spirometry. Mean and standard deviation (SD) were calculated for lung function indices. Chi-square and Fisher's exact tests were used to compare differences among asthmatics and non-asthmatics. The mean pre-bronchodilator lung function indices were also compared for workers who had self-reported asthma with workers who did not have self-reported asthma.

Results

There were 372 textile workers who initially underwent spirometric assessment and 32 (8.6%; 95% Confidence Interval [CI]: 6.1-11.8) were found to have obstructive pattern, while 31(8.3%; 95% CI: 5.9-11.5) were found to have restrictive pattern and 8(2.1%; 95% CI: 1-4.1) workers showed a mixed pattern for lung function impairment. The overall prevalence of asthma diagnosed on spirometry was 19(5%; 95% CI: 3-7.8) while 15 (4%; 95% CI: 2.4-6.5) had self-reported asthma and 8(2.1%; 95% CI: 1-

Table-1: Respiratory symptoms.

Respiratory symptoms	Asthma n (%)	No Asthma n (%)	p-value
Frequent cough[a]			
present	6 (31.6)	53 (15.0)	0.09
absent	13 (68.4)	300 (85.0)	
Chronic cough[b]			
present	3 (15.8)	25 (7.1)	0.16
absent	16 (84.2)	328 (92.9)	
Frequent phlegm[a]			
present	8 (42.1)	91 (25.8)	0.11
absent	11 (57.9)	262 (74.2)	
Chronic phlegm[b]			
present	6 (31.6)	42 (11.9)	0.02
absent	13 (68.4)	311 (88.1)	
Chest tightness ever[c]			
present	9 (47.4)	115 (32.6)	0.18
absent	10 (52.6)	238 (67.4)	
Chest tightness apart from cold[d]			
present	4 (21.1)	66 (18.7)	0.5
absent	15 (78.9)	287 (81.3)	
Frequent wheeze[e]			
present	10 (52.6)	137 (38.8)	0.23
absent	9 (47.7)	216 (61.2)	
Chronic wheeze			
present	7 (36.8)	76 (21.5)	0.11
absent	12 (63.2)	277 (78.5)	
Shortness of breath-I[f]			
present	11 (57.9)	163 (46.2)	0.31
absent	8 (42.1)	190 (53.8)	
Shortness of breath-II[g]			
present	7 (36.8)	71 (20.1)	0.08
absent	12 (63.2)	294 (79.9)	
Self-reported asthma			
present	5 (26.3)	10 (2.8)	<0.001
absent	14 (73.7)	343 (97.2)	
Physician diagnosed asthma			<0.001
Present	4 (21.1)	4(1.1)	
absent	15 (78.9)	349(98.9)	

a. Question asked: do you usually cough/bring up phlegm 5 or more days of the week? A frequent symptom is one which occurs on most days of months for 3 consecutive months or more during the year.

b. Chronic applies for symptoms present for more than 2 years

c. Question asked: does your chest ever feel tight and/or your breathing becomes difficult?

d. Question asked: does your chest feel tight and/or your breathing becomes difficult occasionally apart from cold?

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?

Table-2: Socio-demographic and occupational characteristics.

Variable	Asthma present n (%)	Asthma absent n (%)	p-value
Age (in years)			
18-27	7 (36.8)	238 (67.4)	0.01
28-37	6 (31.6)	68 (19.3)	
38 and above	6 (31.6)	47 (13.3)	
Educational status			
Educated	13 (68.4)	262 (74.2)	0.6
Uneducated	6 (31.6)	91 (25.8)	
Socio-economic status			
High	2 (10.5)	91 (25.8)	0.15
Low	17 (89.5)	262 (74.2)	
Marital status			
Never-married	13 (68.4)	178 (50.4)	0.15
Ever-married	6 (31.6)	175 (49.6)	
History of smoking			
Non-smokers	10 (52.6)	205 (58.1)	0.04
Smokers	9 (47.4)	148 (41.9)	
Pack years of smoking			
None	10 (52.6)	205 (58.1)	0.007
<10 pack years	4 (21.1)	126 (35.7)	
≥10 pack years	5 (26.3)	22 (6.2)	
History of work in dusty job			
Yes	12 (63.2)	156 (44.2)	0.106
No	7 (36.8)	197 (54.8)	
Self-perceived dust levels at work[a]			
Mild	6 (50.0)	58 (37.2)	0.18
Moderate	2 (16.7)	66 (43.2)	
Severe	4 (33.3)	32 (20.5)	
Section of mill			
Spinning	14 (73.7)	160 (45.3)	0.01
Weaving	5 (26.3)	193 (54.7)	
Duration of work in textile industry			
1-5years	2 (10.5)	116 (32.9)	0.01
6-10years	5 (26.3)	127 (36.0)	
>10 years	12 (63.2)	110 (31.2)	
Family history of asthma			
None of the parents	16 (84.2)	336 (95.2)	0.7
Any one of the parents	3 (15.8)	30 (4.8)	

a. Self-perceived dust levels at workplace among 168 textile workers reporting dust exposure at work.

4.1) reported physician-diagnosed asthma when assessed through the questionnaire.

Mean values for lung function indices in ml (pre-bronchodilator) were recorded as FVC: 4099±777; FEV1: 3279±698; and FEV1/FVC ratio: 0.8±0.08.The mean values for FEV1 and FEV1/FVC ratio were found to be low among those who had self-reported or physician-diagnosed asthma compared to those without asthma.

There was low sensitivity for the questions regarding self-reported asthma (26%) and physician-diagnosed asthma (21%) when calculated against asthma prevalence estimated through post-bronchodilator spirometry. Positive predictive values (PPVs) were found to be comparatively higher for self-reported (33%) and

physician-diagnosed asthma (50%). Generally, the respiratory symptoms were found to have low sensitivity and specificity with low PPV. Sensitivity and specificity for shortness of breath (grade-I) was found to be 58% and 46% respectively. However, the validity of various respiratory symptoms could not be assessed further due to an overall low prevalence of asthma found in the study group.

Textile workers who were found to be asthmatic (on spirometry) 6(32%) were more likely to report chronic phlegm than non-asthmatics 42(11.9%) (p=0.02). Out of self-reported asthmatics, 5(26.3%) were diagnosed with asthma on spirometry, and 4(21.1%) were found to have physician-diagnosed asthma (Table-1).

Out of the total number of textile workers who had asthma, 6(32%) were found to be in the older age group of 38 years and above compared to the non-asthmatics 47(13.3%) (p=0.01).Workers who had asthma were more likely to be smokers 9(47.4%) compared to non-asthmatics 148(41.9%) (p=0.04). Similarly, asthmatic workers were more likely to report ≥10 pack years of smoking 5(26.3%) compared to non-asthmatics 22(6.2%) (p=0.007).In terms of the section of mill, 14(73.7%) workers were in the spinning section compared to 160(45.3%) non-asthmatics (p=0.01). Duration of work in asthmatic workers was more than 10 years in 12(63.2%) compared to 110(31.2%) non-asthmatics (p=0.01) (Table 2).

Discussion

To the best of our knowledge this is the first study estimating asthma prevalence among textile workers using three different criteria i.e. self-reported, physician-diagnosed and through lung function assessment. Textile workers have been identified at a greater risk of asthma due to work-related exposures.[2] Nevertheless there is a wide variation in previously reported estimates for asthma among textile workers ranging from 4% to 57%.[6,7,17] This wide variability in asthma estimates is due to lack of a universally accepted definition of asthma and use of different tools and methods for asthma assessment.[10]

In this study the prevalence of physician diagnosed asthma among textile workers was low i.e. (2.1%; n=8; 95% CI: 1-4.1) compared to prevalence of for physician-diagnosed asthma among the general population in Pakistan (3.1%). These estimates are also low compared to estimates for physician-diagnosed asthma reported for general populations of some other developing countries like India (3.1%) and Iran (2.8%).[17] There is limited information available regarding asthma diagnosed on spirometry among general adult population globally. However, the prevalence of asthma diagnosed on spirometry in this study i.e. 5% was found to be much lower compared to estimates from general population of South Australia assessed using spirometry (2.3%).[18] This relatively low prevalence of asthma among textile workers may possibly be due to exposure to bacterial endotoxin. This assumption is consistent with previous studies reporting a protective effect of endotoxin exposures on asthma among farmers and textile workers.[9,19] However, this finding may also be due to the healthy worker effect in our study leading to underestimation of respiratory symptoms and actual asthma burden among textile workers.[20,21] Further research, using larger sample size, is required to establish this association.

The possible reasons for low sensitivity and specificity of questions related to respiratory symptoms for diagnosis in our study could be the very low number of asthmatics found in this study population. However, we should be cognizant of the fact that questionnaire-based assessment may result in underestimation of the burden of asthma when used alone.[10] Therefore, it is advisable to use the questionnaire in combination with either spirometry or bronchial hyper reactivity test to improve the sensitivity of assessment.[8] The bronchial challenge test is a more sensitive but less specific method to detect asthma compared to respiratory questionnaire.[8,10]

A study from Ethiopia reported the highest prevalence of asthma among textile workers at the blowing section (20.5%)[7] and the lowest prevalence at simplex and weaving sections, 7% and 8.5% respectively.[7] In our study, work at spinning section was found to be significantly associated with increased burden of asthma compared to the weaving section and this finding is consistent with previous studies.[7]

Our study reports that textile workers who were asthmatic were more likely to be smokers and were more likely to have greater than 10 pack years of smoking compared to the non-asthmatics. The association between smoking and asthma is still unclear, and several studies have reported no association of asthma with smoking.[22] However, there is a growing body of evidence which shows that this may be a plausible association.[23] Recent data from community-based cross-sectional surveys conducted in Sweden report strong association of smoking with respiratory symptoms and accompanying population attributable risk (PAR) for asthma symptoms attributed to smoking between 9.8-25.5%.[23]

Family history of asthma has been shown to be an important risk factor for the development of asthma.[24] However, in our study, although asthmatics were more

likely to have family history, the results were not statistically significant. This may be due to limited number of asthmatics found in our study.

This study has certain limitations. As this study estimated asthma prevalence among textile workers working in spinning and weaving sections of mills, it may limit the generalisability of the estimates to the overall textile industry. However, these sections have high exposure to gram-negative bacterial endotoxin containing cotton dust and, therefore, will give a reasonable estimate of burden of asthma among workers exposed to cotton dust. In addition, our questionnaire didn't capture the information whether workers continuously worked in the same section of textile mills or not. Since some textile workers may have worked in the same industry and in the same section for merely one year, this could have led to an underestimation of the prevalence of asthma.

The overall low prevalence of asthma might be influenced by the healthy worker effect which may be evident from the documented rapid turnover in textile industries of Karachi.[25]

The American Thoracic Society questionnaire (ATS-DLD-78A) doesn't offer composite score for any combination of symptoms to diagnose asthma on the basis of respiratory symptoms, which may limit the diagnostic utility of the questionnaire.[14] Availability of any such scores could be assessed for the possible correlation with spirometry findings for improved diagnosis.[10] Moreover, previous studies have reported association between dust exposure levels and impaired lung function.[4,8] This study did not measure the overall cotton dust exposure of the workers; hence a correlation between actual levels of cotton dust exposure and lung function could not be assessed. Nevertheless, the study found a significant association between work duration of greater than 10 years and asthma among textile workers, which is consistent with previously reported correlation between chronic loss of pulmonary function and length of exposure (years worked in cotton mills).[21]

Despite having some limitations, the study has certain strengths as well. The study is unique in the sense that it tries to estimate the prevalence of asthma among textile workers using three different criteria. This provides an advantage to our study compared to previous studies which are mostly questionnaire-based. This study used the standard GINA criteria for asthma diagnosis using spirometry and history of physician-diagnosed asthma, as used by WHO Global Health Survey, and, hence, results are comparable with available global estimates.

Conclusion

Textile industry workers exposed to cotton dust have a relatively low prevalence of asthma, suggesting possible protective effect of exposure to endotoxin among textile workers exposed to cotton dust. Questionnaire-based assessment may be used with caution to screen asthma among textile industry workers. A dose-response association needs to be evaluated to establish the protective role of endotoxin exposure in reducing asthma burden. Further assessment is required to identify the role of other related environmental factors besides endotoxin exposures among this occupational group.

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