Respiratory Symptoms and Pulmonary Function of Workers Employed in Textile Dyeing Factory in Turkey

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SUMMARY

Dyes are known to be a causative agent of occupational asthma exposed to them. We evaluate respiratory symptoms among textile. The study population comprised 106 exposed workers and control (unexposed) group. Data were collected by a questionnaire. Pulmonary Function Tests (PFTs) were performed. Among the exposed workers 36.8% defined phlegm. Respiratory symptoms were not significantly different between two groups. The employment duration of the exposed workers with phlegm was longer than those without phlegm (p=0.027). The mean % predicted of forced expiratory flow(FEF $_{25-75}$ of the exposed workers was found to be significantly lower than the control (unexposed) group (p=0.01). Our study suggests that textile dyeing might cause respiratory symptoms at workers.

KEY WORDS:
Textile dyes, Respiratory symptoms, Pulmonary function test

INTRODUCTION

Dyes especially reactive ones are known to be a causative agent of occupational asthma, rhinitis and dermatitis in workers exposed to them [1-4]. Docker et al. showed that more than 15 % of workers handling reactive dyes had work-related respiratory or nasal symptoms and considered that the symptoms could be attributed to an irritant response to chemicals used in this industry, including hydrochloric acid vapor, sulfur dioxide, as well as the reactive dyes themselves[5].

There are numerous publications on the effect of dust on the respiratory system of textile workers employed in processing textile materials such as cotton, hemp, flax and wool [6-14]. However, there are few available study on respiratory function in the workers employed in textile dyeing industry [15].

Viegi *et al.* evaluated respiratory functions in workers of a dyeing factory and found the prevalence of chronic bronchitis and dyspnea as 32 %, flow rates were significantly lower than reference values [16].

We planned this study to evaluate chronic respiratory symptoms among textile workers exposed to textile dyes and compare the respiratory symptoms and results of PFTs of exposed workers with a control group who were not exposed to textile dyes at work. To the best of our knowledge, this is the first study in our country (Turkey) which evaluates respiratory symptoms and PFTs of textile workers exposed to textile dyes.

MATERIALS AND METHODS

This study was conducted at textile dyeing factories. Among the textile dyeing factories located in Denizli Industrial Zone which has over a hundred textile factories, three of them which have given permission for the study were included in the research. These there factories were expert in textile dyeing, and had over two hundred workers in each. Data were collected from 106 exposed workers 106 for the control (unexposed) group (working in the managerial department of the textile dyeing factory). Exposed workers in terms of avoiding collection bias, all data, including questionnaires, were collected by two experienced pulmonologists. Data on demographics, episodes of wheezing or chest tightness, symptoms of dyspnea, cough, phlegm, any other allergic and/or respiratory symptoms, duration of symptoms, past medical history (Are there pulmonary diseases which diagnosed by a doctor in the past? and pulmonary diseases were not particularly investigated that they were related to their occupational history, only they were questioned by a questionnaire.), smoking habits were collected by a questionnaire modified from American Thoracic Society Questionnaire[17]. The questionnaire was administered in a person to person interview.

Pulmonary function tests were performed according to American Thoracic Society criteria while the patients were at rest and seated in the upright position with a portable spirometer (MIR Spirobank). A minimum of three satisfactory forced expiratory manoeuvers was required of each subject. A satisfactory test required that the forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) of two manoeuvers was reproducible within 5% [18]. Analyses were performed on the largest FVC and FEV_1 expressed as percentage of the predicted value. The FVC, FEV_1 and forced expiratory flow at 25% to 75% of the FVC (FEF_{25-75}) and peak expiratory flow (PEF) were determined.

Non-smokers were defined as those who had never smoked regularly, smokers were currently smoking at least one cigarette daily, ex-smokers were those who had formerly smoked regularly but gave it up at least 6 months before the study.

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Control (unexposed) subjects (n=106) were employees in the managerial department of the textile dyeing factory and had similar age, sex, smoking habit, social and economic status. The same questionnaire and PFTs were performed on the control group.

The dyeing was performed in several large open vats located in a large area with temperature of 60 °C to 80 °C. The cotton materials were first sorted by type and then manually placed into vats and boiled for one hour.

The dyeing process used different types of commercially available azo and reactive dyes in addition to many other chemical agents. The dyes included: reactive dyes; azo and anthraquinone derivate. The dyes were purchased from Germany.

Before dyeing, the materials are treated with acetic acid (CH3COOH), formic acid (HCOOH), sodium hydroxide (NaOH), sodium hydrosulphide (NaHS). At high temperatures vapors of different agents are released including hydrogen (H2S) and nitrogen oxides (when azo dyes are used), as well as other vapors released from dyes, which may be found in the workplace atmosphere and inhaled by exposed workers. These workers were also exposed to high temperatures and to a high relative humidity in working place.

Statistical Analysis

Descriptive statistics (including Mean±SD, frequency and percentage) were calculated for two groups separately. The difference between the means of variables in two groups was compared using Independent Samples t test and the difference between the medians of variables in two groups was compared using Mann Whitney U test. The Chi-Square test was used to compare categorical variables. The statistical significance was set at $p<0.05$. The statistical analyses were performed with the statistical package program SPSS version 11.5.

RESULTS

Our study population comprised 106 workers (23.6% female and 76.4% male) with a mean age of 29.51±0.56 yrs. Employment duration of the exposed workers was 65.39±55.69 months. Control group (unexposed) comprised 106 workers (16% female, 84% male) with a mean age of 30.91±0.78 yrs. The demographics and smoking data of the two groups are presented in Table I.

Respiratory symptoms among the workers and control group are presented in Table II.

Among the exposed workers 36.8% reported having phlegm. Other respiratory symptoms were 34% atopy, 27.4% wheezing, 25.5% cough and 14.2% dyspnoea. These symptoms were not significantly different between the exposed workers and the control (unexposed) group.

Comparison of employment duration means by phlegm and atopy are presented in Table III.

When the employment duration of the workers with and without phlegm is compared, there was statistically significantly difference; the employment duration of the exposed workers with phlegm was longer than those without phlegm (p=0.027). The employment of duration of those with atopy was found to be longer than those without (p=0.019).

Pulmonary diseases (tuberculosis, asthma, bronchitis) among the exposed workers and control group are presented in Table IV.

PFTs were performed on 106 exposed workers and 106 (unexposed) controls. The results of PFTs of the exposed workers and the control (unexposed) group are presented in Table V.

Table I: The descriptive statistics (Mean±SD, frequency and percentage) of the exposed workers and control (unexposed) group

	Exposed workers (n=106)	Control (unexposed) group (n=106)	p
Mean age (±SD)	29.51±0.56	30.91±0.78	NS
Number of females	25 (23.6 %)	17 (16 %)	NS
Number of males	81 (76.4 %)	89 /(84 %)	NS
Smoker	54 (50.9 %)	52(49.1 %)	NS
Non-smoker and ex-smoker	52 (49.1 %)	54 (50.9 %)	NS
Cigarette (per-day)	6.44±0.79	6.71±0.84	NS
Employment duration (months)	65.39±55.69	75.53±73.63	NS

NS: Not significant, p>0.05

Table II: Respiratory symptoms among the exposed workers and the control (unexposed) group

	Exposed workers		Control (unexposed) group		p
	n	(%)	n	(%)	
Cough	27	(25.5)	23	(21.7)	NS
Wheezing	29	(27.4)	28	(26.4)	NS
Dyspnoea	15	(14.2)	16	(15.1)	NS
Phlegm	39	(36.8)	41	(38.7)	NS

NS: Not significant, p>0.05

Table III: Comparison of employment duration means by phlegm and atopy

	Employment duration (month, Mean±SD)	p
Phlegm (+)	76.28±58.02	p=0.027
Phlegm (-)	66.93±69.36	
Atopy (+)	83.04±73.71	p=0.019
Atopy (-)	63.57±59.41	

Table IV: Tuberculosis, asthma, bronchitis among the exposed workers and control (unexposed) group

	Exposed workers (n=10)	Control (unexposed) group (n=7)
Tuberculosis	1	-
Asthma	1	1
Bronchitis	8	6

Table V: The descriptive statistics (including Mean±SD) and the significance levels of PFTs of the exposed workers and the control (unexposed) group

PFT	Exposed workers Actual value	Control (unexposed) group Actual value	p
FEV_1 (L/sc)	3.68±0.73 (96.16±11.75)*	3.76±0.55 (98.43±11.69)*	NS
FVC (L)	4.31±0.89 (95.82±12.61)*	4.30±0.64 (96.28±12.52)*	NS
FEV_1 / FVC (%)	85.15 ±5.94 (104.13±7.43)*	85.84±10.31 (106.09±8.02)*	NS
PEF (L/sc)	7.29±1.78 (80.34±13.97)*	7.69±1.60 (84.52±16.30)*	NS
FEF_{25-75} (L/sc)	4.21±1.13 (88.99±19.41)*	4.46±0.97 (96.31±21.16)*	p=0.01

* Predict values %
NS: Not significant, p>0.05
The mean % predicted of FEF 25-75 of the exposed workers was found to be significantly lower than the control (unexposed) group (p=0.01).

DISCUSSION

In our study, symptoms were not significantly different between the exposed workers and the control (unexposed) group. Employment duration was higher in exposed workers with phlegm and atopy. The mean % predicted of FEF_{25-75} of the exposed workers was found to be significantly lower than the control (unexposed) group.

Zuskin *et al.* presented that there were significantly higher prevalences of all chronic respiratory symptoms compared to the control workers in the male dyeing workers, and for the female dyeing workers, the differences were significant for dyspnea, rhinitis, sinusitis [15]. In another study, there were not significant differences the prevalence of respiratory symptoms between men and women [19]. In our study, because of the low number of women, the analyses were done on both gender.

Workers employed in textile dyeing industries may have developed acute and chronic respiratory symptoms [15]. In a study, prevalences of chronic respiratory symptoms in exposed workers were significantly higher than in control workers [15]. Park et al. reported that 25.2% of reactive-dye exposed workers had work- related lower respiratory symptoms 20. In a survey which was conducted at 15 textile plants with dyehouses in western Sweden, 162 were exposed to reactive dyes and 10 of these (%6) reported work- related respiratory symptoms 4. In our study, 36.8% of the exposed workers defined phlegm. Other respiratory symptoms were 34% atopy, 27.4% wheezing, 25.5% cough and 14.2% dyspnoea. These symptoms were not significantly different between the exposed workers and the control (unexposed) group. Our findings are not in agreement with the result of these studies. This might be due to the exposed workers and the control (unexposed) group had similar smoking habit and employment durations of both two groups were short. The similarity of the respiratory symptoms were in the exposed workers and the control (unexposed) group that might be related "healty workers effect".

Zuskin *et al.* found that the exposed nonsmoking workers had more complaints than the controls who were nonsmokers, and the respiratory symptoms were exacerbated by cigarette smoking [15]. However, Luo et al. showed that there was no significant relation between small airway abnormalities or obstructive lung abnormalities and smoking status [21]. We did not compared smoking status of exposed workers and control (unexposed) group, because of their smoking habits were similar.

In a study by Zuskin et al. showed that in workers exposed for higher than 10 years, there were significantly higher prevalences of chronic cough and chronic phlegm in smokers than in nonsmokers [15]. Our finding that employment duration was higher in exposed workers with phlegm and atopy.

In a study, there was a significant dose response relationship of respiratory tract irritation symptoms among the epichlorohydrin (ECH)-exposed workers [21]. Our study is limited because dyeing concentration exposure of workers and control (unexposed) group wasn't performed.

Workers demonstrated significant decreases in all ventilatory capacity tests in males and FEF_{50} and FEF_{25} for female workers [15]. Another study demonstrated that reduced lung function in reactive-dye induced occupational asthma[1]. Small airways under 2 mm in diameter are the primary site of deposition of inhaled toxins and can be affected earliest. FEF_{25-75} is a simple, sensitive and early indicator of obstruction in smaller airways [22]. Twenty-eight of 79 (35.4%) ECH exposed workers had obstructive or small airway lung lesions [21]. In our study, the mean % predicted of FEF_{25-75} levels was significantly lower in the exposed workers. FEF_{25-75} might be considered as a measure of caliber concerning distal airways, particularly in subjects with normal FEV_{123}. FEF_{25-75} may be envisaged as a marker of initial bronchial damage [24].

CONCLUSION

To the best of our knowledge, this is the first study in our country (Turkey) which evaluates respiratory symptoms and PFTs of exposed workers who work in textile dyeing factory. Our study suggests that textile dyeing might cause some respiratory symptoms in exposed workers. Further studies are needed for worker health.

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