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Evaluation of respiratory system in textile-dyeing workers

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Abstract

Background: Despite the presence of many textile and dyeing plants in Iran, we couldn't find similar studies in this country. Forthermore, considering progress in the dyeing process and engineering controls, assessment of respiratory system is important for these workers. The present study was performed to evaluate the respiratory system in dyeing workers.

Methods: In a cross-sectional study, 101 dyeing workers (all dyeing workers in yazd) and 90 workers without respiratory exposures (control group), were evaluated. A questionnaire was filled for each participant included Venables questionnaire and some other questions about age, work experience, personal or familial history of asthma or atopy, acute and chronic respiratory symptoms; Then spirometry was performed before and after the shift work

Results: The frequency of acute and chronic respiratory symptoms was significantly higher among dyeing workers than controls. According to the Venables questionnaire, 11.9% of the dyeing workers suffered from asthma. Means of FVC and FEV1 of pre-shift spirometry were lower than control ($p< 0.001$). Across-shift spirometry showed significant reduction of FVC ($p< 0.001$), FEV1 ($p< 0.001$), FEF25-75% ($p= 0.05$) and FEF25% ($p= 0.007$) in dyeing workers compared to the control group.

Conclusion: Evaluation of dyeing workers' respiratory system in this study showed that despite development in dyeing processes and engineering controls, workers in this job show more prevalent acute and chronic symptoms, and across-shift changes in spirometric parameters were significantly higher in this work group than the control group. Therefore it is necessary to pay attention to the control of respiratory exposures in this job.

Keywords: Respiratory symptoms, Spirometry, Textile insustryasthma.

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Introduction

The textile industry consists of several processes including dyeing in which due to the nature of the work and its exposures, workers may frequently complain of respiratory symptoms. There are many studies about the effects of various textile dusts on the respiratory system, such as the effects of cotton dust (1-5), flax (6-8), hemp (9-11) and wool fibers (12-14), but little information is available about the pulmonary function of dyeing workers (15).

Dyeing workers have exposure to both allergens (e.g. reactive d yes) and irritants (e.g. H_2S, SO_2 and nitrogen oxides). A high-humidity workplace increases the effect of these chemicals on the respiratory system as well (15).

Reactive dyes are extensively used in textile industry due to their ability to make strong covalent bonds with the fibers (15). For the first time, in 1987, Alanko

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described four cases of asthma due to reactive dyes among dye powder weighting workers (16). Following this study, Runstukova and Kalas found 8 cases with symptoms of occupational asthma from 106 textile workers exposed to reactive dyes (17).

Eugenija Zuskin et al. studied pulmonary function among dyeing workers. They used a questionnaire and across-shift changes in spirometric parameters for evaluation. Their results showed that the prevalence of acute and chronic respiratory symptoms in dyeing workers was higher than control group. All spirometric parameters decreased after work shift in male workers and significant decrease was seen in forced expiratory flow (FEF)25–75% and FEF50% and FEF25% in female workers (15).

To the best of our knowledge, there are few studies about pulmonary function tests in dyeing workers. A study on workers in carpet industry in 2003 evaluated the effect of workplace exposures on respiratory system in all units of the carpet industry. They indicated that dyeing workers more frequently complain of respiratory symptoms than other workers. The most frequent pattern of spirometry in dyeing workers was obstructive pattern (18).

Recently, after several years, a study was done in Turkey. They only evaluated chronic respiratory symptoms and pre-shift spirometric parameters. Their results showed that chronic respiratory symptoms was not significantly different between dyeing workers and control group and the mean FEF25-75% of dyeing workers was significantly lower than control group (19). But this study didn’t evaluate acute symptoms and across-shift spirometry. Despite there are many textile and dyeing plants in Iran, we couldn’t find similar studies in this country.

It seems that considering the changes in the dyeing processes over the years and introduction of new engineering control measures, it is necessary to reassess the pulmonary function of dyeing workers and the effectiveness of controlling activities.

This study was designed to evaluate the respiratory symptoms and pulmonary function of dyeing workers in textile industry.

Methods

This was a cross-sectional study conducted on textile dyeing workers selected from all textile plants with dyeing unit throughout the Yazd province (A central procvince in Iran, with a large number of textile plants). Totally, a group of 101 male dyeing workers entered the study and compared with 90 male textile workers in the same industry as a control group (control group exposed to acrylic fibers and had no history of exposure to natural fibers and dyes at work). Inclusion criteria of study groups was negative history of exposure to respiratory pollutants in their previous or second jobs. Two groups were matched regarding age and work experience.

Demographic data including age, work experience, history of previous or second job, smoking habit, personal and familial history of asthma or atopy, and using respiratory protective devices were evaluated.

Prevalence of respiratory symptoms was evaluated by Venables questionnaire (20) with additional questions on chronic respiratory symptoms (cough or phlegm more than 3 months per year (21)) and acute symptoms during work shift, including eye irritation, redness or itching, rhinorrhea, nose bleeding, nasal congestion, irritation and itching of throat, and headache. Venables questionnaire consists of nine questions about respiratory symptoms during the last year. Respiratory symptoms were assessed as yes or no questions and include cough, chest tight-ness and wheeze during climbing stairs or running; difficulty in breathing and wheeze which breaks sleep; difficulty in breathing and wheeze which appears in the morning; and wheeze in a smoky or very dusty place. At least 3 positive responses to 9 questions of the questionnaire would diagnose asthma or airway hyper-responsiveness with 65-91% sensitivity and 85-96% specificity (20). The persian version of venable questionaire was used which was validated by expert opinions, so as three proffessionals in this field reviewed the translated version and after some minor changes, approved it.

Spirometry was performed for all subjects in sitting position with a flow-type spirometer (spirolab III, Mir, Italy). This device is autocalibrated. All tests were performed according to the guidelines recommended by American Thoracic Society/European Respiratory Society (ATS/ERS) taskforce (22). Acceptability criteria was considered according to ATS/ERS taskforce (a satisfactory start of test and end of test criteria i.e. volume of extrapolation less than 5% of FVC or 0.150 L and forced expiration which continued for at least 6s or 1s plateau in the volume–time curve was seen). Spirograms were repeated until three acceptable tests were obtained. Maneuvers were considered repeatable if the largest and second largest values for FVC and FEV1 were within 150 mL of each other. The following spirometric parameters were recorded: Forced vital capacity (FVC), Forced expiratory volume in 1 sec (FEV1), FEV1/FVC% ratio, and Forced expiratory flow rates (FEF25-75%, FEF25%, and FEF75%).

Tests were performed in two occasions for each subject: 6 AM (before shift) and 2 PM (after shift) in the same day. The condition of the room for both tests was kept constant. Those persons with factors contradicting or intervening with spirometry maneuver were excluded from the study.

Data was analysed by SPSS (ver 17) using student's t test, paired t test, and chi-square test. Level of significance was set at $p < 0.05$. An informed consent was obtained from each participant. This study was derived from a residency thesis in occupational medicine and was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences.

Results

Age, height, weight and duration of employment in the two groups were similar (Table 1).

Five percent (n= 5) of dyeing workers and 4.4% (n= 4) of controls were smokers and there was no difference between the two groups regarding smoking (p= 1).

Table 2 presents the prevalence of acute symptoms in dyeing workers and control group. All acute symptoms were significantly more prevalent in dyeing workers than subjects in the control group

Table 1. Demographic and occupational history of dyeing workers and control group

	Group	Minimum	Maximum	Mean	SD	p-value
Age (year)	Dyeing	21	48	31.4	6.1	
	Control	23	48	32.0	6.1	0.48
Height (cm)	Dyeing	163	186	174.2	5.2	
	Control	161	187	175.3	5.7	0.35
Weight (kg)	Dyeing	64	96	78.4	9.4	
	Control	66	98	76.3	9.6	0.31
Work experience (year)	Dyeing	0.8	20	7.0	5.1	
	Control	1	20	8.2	5.2	0.10

Table 2. Frequency of acute symptoms in dyeing workers and control groups

	Eye irritation	Eye itching	Eye redness	Rhinorrhea	Nose bleeding	Nasal congestion	Irritation of throat	Itching of throat	Headache
Dyeing (n=101)	28 (28.7%)	29 (28.7%)	18 (17.8%)	17 (16.8%)	5 (5%)	25 (24.8%)	18 (17.8%)	17 (16.8%)	33 (32.7%)
Control (n=90)	7 (7.8%)	3 (3.3%)	6 (6.7%)	6 (6.7%)	0 (0%)	3 (3.3%)	3 (3.3%)	0 (0%)	4 (4.4%)
P-value	<0.001	<0.001	0.020	0.040	0.60	0.001	0.002	0.001	0.001

Number (%)

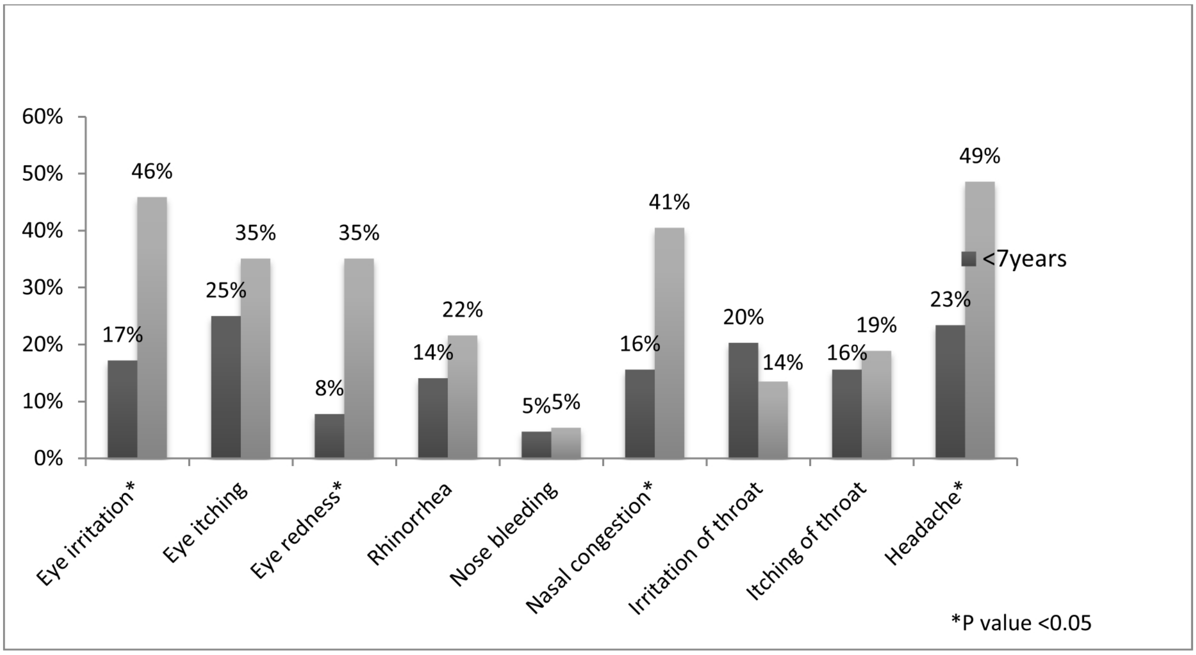

Fig. 1. prevalence of symptoms regarding work experience in dyeing and control groups

($p< 0.05$ for each acute symptom), but there was no significant difference in terms of nose bleeding between two groups ($p= 0.6$). Headache (32.7%), itchy eyes (28.7%) and eye irritation (27.7%) were the most common symptoms in dyeing workers.

The overall prevalence of chronic symptoms (at least one positive response to cough or phlegm) was significantly higher in dyeing workers (33.7% Vs 18.9%, $p=0.01$). The prevalence of chronic symptoms was not significantly related to age, and work experience ($p> 0.05$).

Figure 1 shows the prevalence of symptoms in two groups regarding work experience (< 7 year or ≥ 7 year). Eye irritation, eye redness, nasal congestion and headache were significantly more common in dyeing workers with work history of greater than 7 years ($p< 0.05$).

According to Venables questionnaire, prevalence of asthma was higher in dyeing workers than subjects in the control group, but the difference was not statistically significant (11.9% Vs 5.6%, $p= 0.13$). History of childhood asthma or individual history of atopy was higher in control group (10% Vs 0%) but in this survey there was no significant relationship between history of asthma (childhood or familial) or atopy and presence of asthma (based on Venables questionnaire).

Pre- shift spirometric values in dyeing workers compared to control group are shown in Table 3. This values showed that mean pre-shift FVC and FEV1 were significantly lower in dyeing workers than control group ($p< 0.001$). FEF25%, FEF25-75%, FEF50% and FEF75% were lower in dyeing workers but the difference was not

Table 3. Mean ± SD of pre-shift spirometric parameters in dyeing and control groups.

	Dyeing workers	Controls	P-value
FVC (lit)	4.13 ± 0.47	4.48 ± 0.80	< 0.001
FVC% predicted	87.90 ± 8.73	95.50± 12.04	<0.001
FEV_1(lit)	3.51 ± 0.41	3.76 ± 0.64	< 0.001
FEV_1% predicted	89.1± 8.60	95.5± 12.20	<0.001
FEV_1/FVC (%)	85.2 ± 6.62	83.7± 4.16	0.090
$FEF_{25-75\%}$ (lit/s)	4.00 ± 1.10	4.10 ± 0.98	0.500
$FEF_{25\%}$ (lit/s)	6.91 ± 1.48	6.93 ± 1.29	0.900
$FEF_{50\%}$ (lit/s)	4.33 ± 1.32	4.38 ± 1.12	0.700
$FEF_{75\%}$ (lit/s)	1.87 ± 0.59	1.85 ± 0.54	0.800

Table 4. Across-shift changes in spirometric parameters in dyeing and control groups

		Across-shift changes		P-value
		Mean ± SD	(%)	
FVC (ml)	Dyeing	-120 ± 0.16	-2.8	<0.001
	Control	-49 ± 0.10	-1.2	
FEV_1 (ml)	Dyeing	-103 ± 0.15	-2.8	<0.001
	Control	+18 ± 0.16	+0.5	
$FEF_{25-75\%}$ (lit/s)	Dyeing	-129 ± 0.44	-2.9	0.050
	Control	-17 ± 0.35	-0.0	
$FEF_{25\%}$ (lit/s)	Dyeing	-144 ± 0.78	-1.6	0.007
	Control	+134 ± 0.57	+2.3	
$FEF_{50\%}$ (lit/s)	Dyeing	-31 ± 0.55	-0.5	0.600
	Control	+1 ± 0.47	+0.9	
$FEF_{75\%}$ (lit/s)	Dyeing	-104 ± 0.26	-4.7	0.080
	Control	-36 ± 0.26	-1.2	

statistically significant. It is noteworthy that FEV1/FVC was not significantly different between two groups in pre-shift spirometry.

Table 4 shows the across-shift changes in spirometric parameters from baseline in two groups. We found a significant across-shift reduction in FVC ($p< 0.001$), FEV1 ($p< 0.001$), FEF25% ($p= 0.007$) and FEF 25-75% ($p= 0.05$) in dyeing workers. The average reduction varied from 1.6% to 2.9%. Across- shift reduction in FEF75% was remarkable in dyeing group but was not significant compared to control group ($p= 0.08$).

Discussion

Dyeing process is performed in an environment with high temperature (60°-79°C) and high humidity (15). Furthermore, both allergic and irritant agents are present in this workplace (23). We found that acute and chronic respiratory symptoms were more prevalent among dyeing workers than subjects in the control group; and the decrease in lung volumes after the work shift was higher in dyeing workers than control group.

The most common symptoms were headache, itchy eye and eye irritation. Some symptoms had significant relationship with work experience; frequency of irritation and eye redness, nasal obstruction and headache were higher in workers with ≥ 7 years work experience.

Zuskin et al. showed that work- related respiratory symptoms have high prevalence in dyeing workers and dryness of the throat and eye irritation were the most common symptoms in them but in their survey, the prevalence of acute symptoms was not compared with a control group. In contrast to our results, there was not a significant relationship between work experience and acute symptoms in their study (15).

In another study, Docker et al. evaluated 400 workers handling reactive dyes and showed that more than 15% of them had work- related respiratory or nasal symptoms. The author explains that these symptoms can be caused due to irritant response to chemical exposure (including hydrochloric acid vapor, sulfur dioxide and reactive dyes) or due to allergic response to other substances (reactive dye is the main reason) (23).

In another survey, 25.2% of workers with exposure to reactive dyes showed work-related respiratory symptoms and in 30% of them specific IgE was detected. The findings suggested that reactive dyes can induce immunologic response especially IgE- mediated reactions (24).

In our study, the prevalence of chronic respiratory symptoms in exposed workers was significantly higher than control group but no significant relationship was seen between the prevalence of chronic symptoms and age or work experience. This result was consistent with Zuskin et al. survey (15). Recently another study evaluated chronic symptoms in dyeing workers and showed there was no significant difference in chronic symptoms between dyeing and control groups (19).

This is against the results of Zuskin et al. (15) and our study. This difference is probably due to lower mean age or employment duration of their cases or due to better engineering controls in their factories.

Correlation of respiratory symptoms with smoking in dyeing workers was not comparable, because of the small number of workers in this group, although we can not be sure about the smoking history due to under-reporting by the workers.

According to Venables questionnaire, the prevalence of asthma in our study was 11.9% but there was no significant difference with control group. It should be noted that the history of atopy or pediatric asthma was significantly more common in control group than dyeing workers and this issue may have caused no significant difference between two groups in the prevalence of asthma.

In addition, 91.6% of asthmatic dyeing workers had acute symptoms. It is in agreement with another study in which subjects with occupational asthma were more likely to have concurrent acute symptoms (25).

Evaluations of spirometric parameters in this study showed that mean pre-shift FVC and FEV1 were significantly lower in dyeing workers. This reflects the chronic effect of exposures on respiratory system and shows that both parameters (FVC & FEV1) have a similar reduction pattern. Rastogi et al. in a survey in carpet industry found that FVC in various groups was not significantly different compared with control group, but FEV1 was significantly lower in dyers, washers and weavers. The researcher has noted that most obstructive patterns were observed in dyeing workers and they believed that occupational exposures such as acids, alkalis, detergents and dyes are responsible for pulmonary impairment in this group (18).

In another study in 1997, pulmonary function in workers employed in dyeing cotton and wool fibers was assessed. They showed that all spirometric values in males and FEF50% and FEF25% in females showed a significant decrease compared to predicted values. Furthermore, male dyeing workers (non-smokers) with more than 10 years of employment had significant decrease in FVC, FEF50% and FEF25% in comparison with predicted values (15).

Sibel Oskurt et al. evaluated only pre-shift spirometric parameter and demonstrated that only FEF25-75% was significantly reduced compared to control group (19). The results of our study showed that reduction in spirometric parameters varies from 0.4% to 4.7%. In comparison with control group, FVC, FEV1, FEF25% and FEF25-75% had significant decrease in across-shift spirometry. Although FEF 50% and FEF75% were clearly reduced after shift in dyeing workers, these changes were not statistically significant compared to control group.

Zuskin et al. evaluated FVC, FEV1, FEF50% and FEF25% and demonstrated that all of these parameters in male workers had significant decrease across shift but the rate of decline in across shift parameters in this study was more than our survey (15). This difference may be due to higher age and duration of employment in their workers or due to regular respirator usage in our workers. In our survey, 87.1% of dyeing workers had used respirator but in Zuskin study, state of respirator usage was not clear.

This study had some limitations: All of workers who were employed in dyeing units were males, so we could not compare the effect of exposures between males and females. To determine the frequency of asthma among dying workers, we could not evaluate late responses, which may have caused false negative results that may have led to reduced prevalence of work-related asthma in this study.

Conclusion

Evaluation of dyeing workers' respiratory system in this study showed that despite development in dyeing processes and engineering controls, workers in this job show acute and chronic symptoms more prevalently than control group, and across-shift changes in spirometric parameters were significantly higher in this work group than control group. High prevalence of acute symptoms during work, especially eye symptoms, shows that ventilation is insufficient or application of personal protective devices is not appropriate.

Further studies are recommended to perform peak flow-metry after shift for evaluation of the late response; it can be a more accurate assessment of the prevalence of occupational asthma in these workers.

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References

1. Beck GJ, Schachter EN, Maunder LR, Schilling RS. A prospective study of chronic lung disease in cotton textile workers. Annals of internal medicine 1982;97(5):645-51.

2. Christiani DC, Wang XR, PAN L, ZHANG HXI, SUN BIX, DAI H, et al. Longitudinal Changes in Pulmonary Function and Respiratory Symptoms in Cotton Textile Workers A 15-yr Follow-up Study. American journal of respiratory and critical care medicine 2001;163(4):847-53.

3. McKerrow C, McDermott M, Gilson J, Schilling R. Respiratory function during the day in cotton workers: a study in byssinosis. British journal of industrial medicine 1958;15(2):75.

4. Boubopoulos NJ, Constandinidis TC, Froudarakis ME, Bouros D. Reduction in cotton dust concentration does not totally eliminate respiratory health hazards: The Greek study. Toxicology and Industrial Health 2010;26(10):701-7.

5. McElvenny DM, Hurley MA, Lenters V, Heederik D, Wilkinson S, Coggon D. Lung cancer mortality in a cohort of UK cotton workers: an extended follow-up. Br J Cancer 2011;105(7):1054-60.

6. Valić F, Žuškin E. Effects of different vegetable dust exposures. British Journal of Industrial Medicine 1972;29(3):293-7.

7. Elwood PC, Pemberton J, Merrett J, Carey G, McAulay I. Byssinosis and other respiratory symptoms in flax workers in Northern Ireland. British journal of industrial medicine 1965;22(1):27-37.

8. Nakladalova M, Fialova J, Skalova A. Respiratory Symptoms and Pulmonary Functions in Flax Spinners' Workshops. PRACOVNY LEKARSTVI 2002;54(4):190-4.

9. Zuskin E, Kanceljak B, Schachter EN, Witek TJ, Maayani S, Goswami S, et al. Immunological findings in hemp workers. Environmental Research 1992;59(2):350-61.

10. Fishwick D, Allan LJ, Wright A, Barber CM, Curran AD. Respiratory symptoms, lung function and cell surface markers in a group of hemp fiber processors*. American Journal of Industrial Medicine 2001;39(4):419-25.

11. Stokes JR, Hartel R, Ford LB, Casale TB. Cannabis (hemp) positive skin tests and respiratory symptoms. Annals of Allergy, Asthma & Immunology 2000;85(3):238-40.

12. Love R, Smith T, Gurr D, Soutar C, Scarisbrick D, Seaton A. Respiratory and allergic symptoms in wool textile workers. British journal of industrial medicine 1988;45(11):727-41.

13. Moscato G, Catenacci G, Dellabianca A, Lecchi A, Omodeo P, Manfredi S, et al. A respiratory and allergy survey in textile workers employed in early stages of wool processing. Giornale italiano di medicina del lavoro ed ergonomia 2000; 22(3):236-40.

14. Zuskin E, Valic F, Bouhuys A. Effect of wool dust on respiratory function. The American review of respiratory disease 1976;114(4):705-9.

15. Zuskin E, Mustajbegovic J, Schachter EN, Doko-Jelinic J. Respiratory function of textile workers employed in dyeing cotton and wool fibers. American Journal of Industrial Medicine 1997; 31(3):344-52.

16. Alanko K, Keskinen H, BjÖRkstÉN F, Ojanen S. Immediate-type hypersensitivity to reactive dyes. Clinical & Experimental Allergy 1978;8(1):25-31.

17. Kalas D, Runstukova J. The effect of working with ostazine dyes on the development of bronchiospasm and occupational bronchial asthma. Pracovny Lekarstvi 1980;32:103-9.

18. Rastogi S, Ahmad I, Pangtey B. Effects of occupational exposure on respiratory system in carpet workers. Indian Journal of Occupational and Environmental Medicine 2003;7(1):19.

19. Sibel O, Beyza A, Murat K, Fatma E, Göksel K, Sevin B. Respiratory Symptoms and Pulmonary Function of Workers Employed in Textile Dyeing Factory in Turkey. Med J Malaysia 2012;67(4):375.

20. Venables K, Farrer N, Sharp L, Graneek B, Taylor AJN. Respiratory symptoms questionnaire for asthma epidemiology: validity and reproducibility. Thorax 1993;48(3):214-9.

21. Minov J, Karadžinska- Bislimovska J, Risteska-Kuc S, Stoleski S. Chronic respiratory symptoms and ventilatory function in workers exposed to tea dust: effect of duration of exposure

and smoking. Facta Universitatis 2005;12(1):37-43.

22. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardisation of spirometry. The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology 2005;26(2):319-38.

23. Docker A, Wattie JM, Topping MD, Luczynska CM, Newman Taylor AJ, Pickering CA, et al. Clinical and immunological investigations of respiratory disease in workers using reactive dyes. British Journal of Industrial Medicine 1987; 44(8): 534-41.

24. Park HS, Lee MK, Kim BO, Lee KJ, Roh JH, Moon YH, et al. Clinical and immunologic evaluations of reactive dye-exposed workers. Journal of allergy and clinical immunology 1991; 87(3): 639-49.

25. Susan MT MC. Occupational asthma. In: Linda Rosenstock MRC, Carl Andrew Brodkin, Carrie A edlich, editor. Textbook of Clinical Occupational and Enviromental Medicine. 1. 2 ed. p. 437-51.