

Respiratory Findings in Art Students

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ABSTRACT

Art students are exposed to many noxious agents during their training. We studied respiratory findings in a cohort of the 117 art students in order to investigate the potential effects of these toxic agents in the art student's environment. A group of 88 medical students matched for age, sex and smoking, not exposed to known environmental pollutants were studied as controls for respiratory symptoms. Respiratory symptoms acute and chronic were evaluated by modifying the British Medical Research Council questionnaire. Lung function studies were performed with a spirometer (Jaeger, Germany) measuring maximum expiratory flow-volume (MEFV) curves. Significantly higher prevalences of most of the chronic respiratory symptoms were recorded in art compared to medical students ($p < 0.05$). Art students who were smokers had significantly higher prevalences of many of the chronic respiratory symptoms than nonsmoking art students. High prevalences of acute symptoms related to the study environment were recorded for art students. Odds ratios in male art students were significant for chronic cough, chronic phlegm and chronic bronchitis for the risk factors of exposure and smoking. Significantly decreased lung function was recorded for FVC, FEF50 and FEF25 in male and FVC, and FEF25 in female art students. Smokers and nonsmokers had similar reductions of lung function. Our data indicate that art students may be at risk of developing chronic respiratory symptoms and lung function changes as a result of their exposure and their smoking habits.

Key words: art students, respiratory symptoms, ventilatory capacity

Introduction

The occupational health of artists is of concern because of the potential for exposure to toxic chemicals found in art mate-

rials, the tools and methods they use, and the unregulated setting in which they perform their work¹⁻⁴. Artists frequently

use art materials in small and intensely contaminated workspaces, thereby exposing themselves to toxic materials^{2–5}. Artists are exposed to many of the same hazardous materials that face industrial workers^{6–11}. Artists themselves are often unaware of the health hazards they face and the precautions they should take to protect their health.

The organ systems most frequently affected by these art materials include the respiratory tract (asthma, pulmonary fibrosis, rhino-conjunctivitis) as well as the skin (contact dermatitis)^{2,3,12}.

McCann¹³ and Forastiere et al¹⁴ report that women artists and photographers experienced a significant association between respiratory symptoms (chronic bronchitis and asthma) and occupational factors. Tharr¹⁵ described that printing operators at a magazine, who were exposed to solvents (naphthas and 2-butoxy-ethanol), developed contact dermatitis and respiratory irritation or asthma. Similarly, Cuthbert¹⁶ reported rhinitis and asthma in printing workers caused by molds and paper dust. The potential long-term health effects of many of these substances are only now beginning to be described.

Art students are exposed to most of the same agents that professional artists are exposed to but this group has not received as much attention. In the present study we investigate respiratory findings in a group of art students studying to be painters, sculptors and restorers of old art.

Subjects and Methods

Subjects

This cross-sectional study included a group of 117 art students (48 male and 69 female) attending a small art school in Zagreb, Croatia. The recruited population represented 98% of the all art stu-

dents in the school at the time of the investigation. The mean age was 28.4 years (range: 19 to 32 years). The mean duration of exposure during their study in the school was 5.5 years (range: 1 to 8 years). The usual course of study is 5 years but can extend as long as 6 to 8 years. Art students (48/117; 41.0%) were smokers having smoked an average 6.4 pack-years. These art students were involved in all types of art studies including painting, sculpting, and restoration. They were all exposed to similar unfavorable conditions during their studies. This included exposure to different solvents, dusts (clay, silica, pigments, dyes, paper), gum acacia and molds. Because of similar exposures among the students and the small number of students in each group, we could not separately study art students by their involvement in different stages of their studies. In addition, a group of 88 medical students (40 male and 48 female) not exposed to known atmospheric pollutants was studied as a control group for the prevalence of chronic respiratory symptoms. The ages and smoking habits of these subjects were similar to those of the art student group.

Respiratory symptoms

Chronic respiratory symptoms were recorded in art and medical students using the British Medical Research Council questionnaire on respiratory symptoms¹⁷ with additional questions on occupational asthma^{18–20}. For all students a detailed exposure history as well as questions about their smoking habit were recorded. The following definitions were used:

- Chronic cough or phlegm: cough and/or phlegm for a minimum of three months a year;
- Chronic bronchitis: cough and phlegm for a minimum of three month a year and for not less than 2 successive years;
- Dyspnea grades: 2 – shortness of breath when walking up the hill with other peo-

ple; 3 – shortness of breath when walking with other people at an ordinary pace on level ground;

- Occupational asthma: recurring attacks of dyspnea, chest tightness and pulmonary function impairment of the obstructive type diagnosed by physical examination and spirometric measurements during exposure to dust at or following work (decrease of FEV1 >15%) and confirmed by the medical records

Acute symptoms that developed during exposure hours were also recorded in studied art students. Symptoms included cough, dyspnea, irritation or dryness of the throat, secretion, dryness or bleeding of the nose, eye irritation, headache and vocal cord dysfunction (hoarseness) occurring after high exposure to respiratory irritants.

Ventilatory capacity

Ventilatory capacity measurements were performed in all art students by recording the maximum expiratory flow-volume (MEFV) curves on a spirometer the Pneumoscreen (Jaeger, Wurzburg, Germany). On MEFV curves the forced vital capacity (FVC), one-second forced expiratory volume (FEV1), and maximum flow rates at 50% and the last 25% of the vital capacity (FEF50, FEF75) were read. Measurements were performed during the morning. The spirometer was calibrated on a daily basis. Lung function testing was performed according to the recommendation of Quanjer et al²¹. At least three MEFV curves were recorded for each subject and the best value of the three technically satisfactory MEFV curves was used as the result of the test. The measured values of ventilatory capacity were compared with the predicted normal values of Quanjer et al²². Ventilatory capacity was not measured in control medical students.

Statistical analysis

The Chi-square test (or when appropriate Fisher's exact test) was used for testing differences in the prevalence of respiratory symptoms between groups. Odds ratios and 95% confidence intervals (CI) were calculated using a logistic regression analysis for each respiratory symptom (variables) and age, length of exposure and smoking as predictors²³. The results of ventilatory capacity measurements were analyzed by the paired t-test-comparing baseline to predicted values for the art students. Ventilatory capacity data were also analyzed by applying a multiple regression analysis with age, length of employment and smoking as predictors and percentage of predicted for FVC, FEV1, FEF50 and FEF25 as criteria variables²⁴. A level of $p < 0.05$ was considered statistically significant.

Results

Respiratory symptoms

The prevalence of chronic respiratory symptoms in 117 art and 88 medical (control) students is presented in Table 1. Similar prevalences were obtained in male and female art students and therefore the data were combined together. The highest prevalences of chronic respiratory symptoms in art students were recorded for chronic cough, nasal catarrh and sinusitis, followed by chronic phlegm, chronic bronchitis, dyspnea grade 2 and 3, and hoarseness. Most of the symptoms in art students were significantly higher than in controls ($p < 0.05$; $p < 0.01$). Occupational asthma was recorded only in art students (5.1%) both in smokers and non-smokers. Their symptoms of asthma started after being exposed to different agents in art school. The duration of exposure before the asthma symptoms developed varied from 1–3 years. None of the medical students had asthma.

TABLE 1
CHRONIC RESPIRATORY SYMPTOMS IN 117 ART STUDENTS
AND 88 MEDICAL (CONTROL) STUDENTS

Group	Mean age (yrs)	Mean exposure (yrs)	Chronic cough	Chronic phlegm	Chronic bronchitis	Dyspnea grade 2 & 3	Occupational asthma	Nasal catarrh	Hoarseness	Sinusitis
Art students N=117	28.4±5.0	5.5±5.9	41 35.0%	21 17.9%	20 17.1%	15 12.8%	6 5.1%	34 29.1%	15 12.8%	35 29.9%
Control N=88	26.8±5.7	0	<0.01 3 3.4%	<0.01 1 1.1%	<0.01 1 1.1%	<0.05 0 0%	NS 0 0%	<0.01 1 1.1%	<0.05 0 0%	<0.01 0 0%

NS – difference statistically not significant (p > 0.05)

Table 2 shows that art students smokers had significantly higher prevalences for some of the symptoms than art students who were nonsmokers (p < 0.05). Art students smokers had similar prevalence of occupational asthma as art nonsmoking students. Among medical students, smokers had higher symptom prevalences than nonsmokers, but the differences were not statistically significant (NS).

The highest prevalences of acute symptoms in artists during exposure hours were obtained for eye irritation (38.5%), headache (35.9%), dryness of the nose (24.8%), and dryness and irritation of the throat (22.2%).

Odds ratios for respiratory symptoms demonstrated statistically significant correlation mostly for smoking (chronic cough: OR = 1.239, CI = 1.085–1.414; chronic

TABLE 2
CHRONIC RESPIRATORY SYMPTOMS IN 117 ART AND 88 CONTROL STUDENTS
BY SMOKING HABITS

Group	Smoking habit	Age (yrs)	Exposure (yrs)	Chronic cough	Chronic phlegm	Chronic bronchitis	Dyspnea grade 2 & 3	Occupational asthma	Nasal catarrh	Hoarseness	Sinusitis
Art	Smokers N=48	27.1 ±5.2	5.0 ±6.1	23 47.9%	18 37.5%	18 37.5%	7 14.6%	2 4.2%	10 20.8%	5 10.4%	13 27.1%
	Non-smokers N= 69	29.5 ±5.3	6.0 ±7.0	18 26.1%	3 4.3%	2 2.9%	8 11.6%	4 5.8%	24 34.8%	10 14.5%	22 31.9%
Control	Smokers N=35	26.2 ±4.5	0	2 5.7%	1 2.9%	1 2.9%	0 0%	0 0%	1 2.9%	0 0%	0 0%
	Non-smokers N= 53	27.1 ±5.2	0	NS 1 1.9%	NS 0 0%	NS 0 0%	NS 0 0%	NS 0 0%	NS 0 0%	NS 0 0%	NS 0 0%

NS – difference statistically not significant (p > 0.05)

phlegm: OR = 1.441, CI = 1.223–1.698; chronic bronchitis: OR = 1.453, CI = 1.218–3.734) and exposure (chronic cough: OR = 1.107, CI = 1.033–1.185; eye irritation: OR = 1.065, CI = 1.001–1.132; nose bleeding: OR = 1.090, CI = 1.007–1.180; headache: OR = 1.093, CI = 1.022–1.170) ($p < 0.05$ or $p < 0.01$). For age, OR was statistically significant only for hoarseness (OR = 1.122, CI = 1.009–1.352).

Since data on ventilatory capacity depends on sex, age and height, Table 3 demonstrates the ventilatory capacity data in male and female art students as measured, and percent of predicted. Significantly lower values of FVC, FEF50 and FEF25 in comparison to predicted was found in male and for FVC and FEF25 for female art students ($p < 0.01$; $p < 0.05$).

Separate analysis of ventilatory function in male art students by smoking habit (Table 4) indicated that male smokers as well as male nonsmokers had significantly decreased FEF50 and FEF25 compared to predicted ($p < 0.05$). Among female art students, only FVC in nonsmokers was significantly decreased in relation to predicted ($p < 0.05$).

Discussion

Our study indicates that art students exhibit significantly higher prevalences of many chronic respiratory symptoms compared to controls. In particular, among our art students, asthma associated with work (occupational asthma) was found in 6.3% of male and in 4.3% of female students. Petsonk²⁵ reported that 10–25% of asthma is work related. Wieslander et al.²⁶ reported 7% of asthma in subjects occupationally exposed to water-based paints. Similarly, Fishwick et al.²⁷ described that spray paintings is significantly associated with chronic bronchitis and airway obstruction. Forastiere et al.¹⁴ and Rosenthal and Forst²⁸ reported that among artists, decorators and photographers there

is a significantly increased risk of asthma. Beach et al.²⁹ described that water-based paints contain small amounts of volatile organic compounds with the potential to exacerbate the symptoms of asthma.

More generally very high levels of chronic respiratory symptoms were found in this group of young students compared to the control group of medical students. These differences suggest a high risk for developing lung disease in this cohort.

The art students in this study also demonstrated an elevated prevalence of acute symptoms presumably related to their exposure to noxious agents. Lesser and Weiss⁷ reported on a large number of artists with acute health problems who presented to emergency rooms for diagnosis and treatment. Lu³⁰ described a high incidence of allergic reactions among arts and crafts students who had exposures to art materials for less than 70 hours within a period of 7 weeks. Balich³¹ described similar health risks among medical illustrators associated with art materials used in this profession.

The findings of increased respiratory symptoms were associated with significant odds ratios correlating many of these symptoms with smoking and exposure. Exposure to the art environment was associated with lung function loss in both male and female art students. These findings in the context of high symptom prevalences should be considered as suspicious for obstructive lung disease. They are young individuals and their exposures have been relatively short. The effect of cigarette smoking on lung function at this age is subtle but real³². We suggest similar effects in art young students. These data thus indicate that art students should be made aware of the risks of their occupation and the special hazards that smoking poses for their profession.

Art students should be taught about the special occupational health risks of

TABLE 3
VENTILATORY CAPACITY IN MALE AND FEMALE ART AND CONTROL STUDENTS

Sex	Group	Mean age (yrs)	Mean height (cm)	FVC (L)			FEV1 (L)			FEF50 (L/s)			FEF25 (L/s)			
				Measured	% predicted	p	Measured	% predicted	p	Measured	% predicted	p	Measured	% predicted	p	
Male	Art N=48	26.8 ±7.5	180.1 ±6.2	5.4	96.4	p<0.01	4.6	102.2	NS	5.3	88.3	p<0.01	2.5	83.3	p<0.01	
				±0.8	±10.5	±0.7	±11.5	±1.4	±21.9	±0.8	±24.7					
	Control N=40	27.1 ±8.6	179.2 ±6.1	NS			NS			NS			<0.05			
				5.5	98.2	NS	4.6	102.1	NS	5.7	97.0	NS	2.9	96.7	NS	
				±0.9	±11.0	NS	±0.7	±11.5	NS	±1.6	±24.0	NS	±0.9	±27.5	NS	
	Art N=69	28.2 ±8.5	167.9 ±5.8	3.9	95.1	p<0.01	3.5	102.9	NS	4.7	104.4	NS	2.4	95.0	<0.05	
±0.5				±11.0	±0.5	±11.2	±1.0	±19.6	±0.9	±29.3						
Control N=48	25.0 ±8.1	167.2 ±5.1	NS			NS			NS			NS				
			4.0	97.6	NS	3.5	100.0	NS	4.7	104.1	NS	2.4	100.0	NS		
			±0.4	±10.0	NS	±0.5	±10.2	NS	±1.0	±19.6	NS	±0.9	±29.3	NS		

Data are presented as mean ±SD
NS – difference statistically not significant (p>0.05)

TABLE 4
VENTILATORY CAPACITY IN 48 MALE AND 69 FEMALE ART STUDENTS BY SMOKING HABIT

Sex	Smoking habit	Mean age (yrs)	Mean height (cm)	FVC (L)			FEV1 (L)			FEF50 (L/s)			FEF25 (L/s)		
				Measured	% predicted	p measured	Measured	% predicted	p measured	Measured	% predicted	p measured	Measured	% predicted	p measured
Male N=48	Smokers N=21	27.3 ±9.6	179.2 ±7.3	5.4 ±0.8	96.8 ±11.7	NS	4.6 ±0.8	102.5 ±12.3	NS	5.2 ±1.6	87.0 ±23.6	P<0.05	2.5 ±0.9	80.5 ±27.1	P<0.05
	Non-smokers N=27	26.8 ±8.0	180.1 ±5.3	5.3 ±0.7	94.9 ±9.7	P<0.05	4.6 ±0.6	101.9 ±11.2	NS	5.4 ±1.2	90.5 ±20.9	P<0.05	2.6 ±0.7	85.0 ±22.9	P<0.05
	Smokers N=27	27.0 ±8.0	168.8 ±5.4	4.1 ±0.5	97.2 ±10.5	NS	3.6 ±0.5	103.5 ±11.0	NS	4.7 ±0.8	102.9 ±16.3	NS	2.4 ±0.8	95.0 ±26.5	NS
	Non-smokers N=42	29.5 ±10.9	167.0 ±0	3.8 ±0.5	94.7 ±11.2	P<0.05	3.4 ±0.5	101.8 ±11.4	NS	4.7 ±1.1	104.9 ±21.6	NS	2.3 ±0.9	95.0 ±31.3	NS

Data are presented as mean ±SD; NS – difference statistically not significant (p>0.05)

artists. Students that work with hazardous materials must learn to observe basic safety precautions and should also be educated about safe substitutes for toxic art materials. For instance, training programs should emphasize the following simple preventive measures artists can take to improve their occupational safety: 1) Wash hands before eating to avoid ingesting pigments and solvents; 2) Use solvents only in areas with local exhaust ventilation. 3) Wear protective equipment (gloves, coats, respiratory masks, safety glasses) to avoid skin and eye contact with toxic materials and use proper local or general ventilation as appropriate. 4) Never wash hands with solvents or solvent-containing hand-cleaners. 5) Always wash splashes of toxic materials off the hands with mild soap. 6) Do not smoke. Similar-

ly, preventive measures and smoking cessation should be a high priority for any medical surveillance program.

In targeting a health prevention program for art students, particular attention should be paid to the most vulnerable groups, which include smokers, pregnant women and people with respiratory problems (such as asthma or chronic obstructive pulmonary disease) or allergies. Sensitized individuals can experience health effects to substances at extremely low levels. Periodic medical examinations should be performed; including tests to identify disease known to be caused by exposure to toxic art materials. Smoking cessation should be emphasized, since as suggested by the findings of this study, there is a high likelihood of interactive effects between paints, toxins and tobacco smoke.

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RESPIRATORNI NALAZI STUDENATA LIKOVNE AKADEMIJE

S A Ž E T A K

Studenti umjetničke akademije izloženi su brojnim štetnim agensima tijekom studija. Ispitivana je respiratorna funkcija u skupini 117 studenata likovne akademije u cilju utvrđivanja potencijalnih učinaka toksičnih agensa u okolišu. Skupina 88 studenata medicine slične dobi, spola i navike pušenja bez ekspozicije štetnim agensima ispitivana je kao kontrola za respiratorne simptome. Akutni i kronični respiratorni simptomi utvrđivani su upitnikom Britanskog savjeta za medicinska istraživanja. Plućna funkcija mjerena je registriranjem krivulje maksimalni ekspiracijski protok-volumen (MEFV) na spirometru Jaeger. Značajno viša prevalencija većine kroničnih respiratornih simptoma utvrđena je u izloženoj skupini u usporedbi s kontrolom ($p < 0.05$; $p < 0.01$). Studenti likovne umjetnosti koji su bili pušači pokazivali su višu učestalost većine respiratornih simptoma nego nepušači. Visoka prevalencija akutnih simptoma vezana uz okoliš utvrđena je u studenata likovne umjetnosti. Odds ratios u studenata likovne umjetnosti bio je značajan za kronični kašalj, kronični iskašljaj i kronični bronhitis za rizične faktore kao što su ekspozicija i pušenje. Značajno smanjenje plućne funkcije utvrđeno je za FVC, FEF50 i FEF25 u studenata likovne umjetnosti i za FVC i FEF50 u studentica likovne umjetnosti. Pušači i nepušači pokazivali su slične redukcije plućnih funkcionalnih testova. Naši rezultati upućuju da studenti likovne umjetnosti mogu razviti kronične respiratorne simptome i promjene plućnih funkcionalnih testova kao posljedica njihove ekspozicije i navike pušenja.