

Asthma and Respiratory Symptoms Among Hairdressers in Denmark: Results from a Register Based Questionnaire Study

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Background Hairdressers are at risk of developing occupational respiratory disorders due to persulfates and other hairdressing chemicals.

Methods A register based questionnaire study comprising 7,840 graduates from hairdressing vocational schools was conducted. The postal questionnaire concerned self-reported asthma, airway symptoms, occupation, smoking, and atopic dermatitis.

Results A response rate of 67.9% was obtained. The hairdressers reported asthma (11.2%), cough (25.3%), nasal congestion (24.0%), and rhinitis (18.2%). Less than 1/3 of all hairdressers with suspected occupational asthma reported their asthma as an occupational disease to the authorities. In total, 27.3% were daily smokers; the smoking pattern was similar between hairdressers with and without asthma. Local exhaust ventilation was only used consistently by 63.8% for permanent waving and hair coloring procedures.

Conclusions Asthma and especially respiratory symptoms were commonly reported by hairdressers, but rarely reported as an occupational disease. Local exhaust ventilation was inconsistently used. Our results underline the need for improved measures to ascertain and prevent occupational asthma in hairdressers. *Am. J. Ind. Med.* 57:1368–1376, 2014.

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KEY WORDS: asthma; respiratory tract symptoms; occupational exposure; hairdressers

INTRODUCTION

Occupational skin diseases and musculoskeletal diseases are very frequent in the hairdressing trade [Leino et al., 1999;

Lysdal et al., 2011], but asthma and respiratory symptoms are also known occupational diseases in the profession [Leino et al., 1997a,b; Venables and Chan-Yeung, 1997; Hollund et al., 2001; Brisman et al., 2003; Moscato et al., 2005]. In a recent publication, we showed that 6.1% of ex-hairdressers professed to have left the trade because of asthma [Lysdal et al., 2011].

Ammonium-, potassium-, and sodium persulfate are strongly oxidizing inorganic salts. They are frequently used as active ingredients in hair bleaching products [Fisher and Doooms-Goossens, 1976; Pang and Fiume, 2001] and hair dyes [Pang and Fiume, 2001] at concentrations up to 60% [Pang and Fiume, 2001]. Ammonium persulfate has been identified as a common allergen among hairdressers [Pang and Fiume, 2001; Bregnhøj and S¸st¸ed, 2009; Schwensen et al., 2013].

Persulfates are a common cause of occupational asthma and respiratory symptoms in hairdressers [Blainey et al., 1986;

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Leino et al., 1998; Cruz et al., 2009]. Persulfates have also been reported to cause both delayed type and immediate skin reactions such as allergic and irritant contact dermatitis, localized contact urticaria, and generalized urticaria [Fisher and Dooms-Goossens, 1976; Pang and Fiume, 2001]. Other possible causative agents of asthma and respiratory symptoms among hairdressers are hair sprays, hair dyes, perfumes, vapors, and other volatile solvents [Hollund and Moen, 1998; Albin et al., 2002; Munoz et al., 2004; Moscato et al., 2005]. Some hairdressers may have a predisposition to develop asthma. A known indicator of increased susceptibility is atopic dermatitis in childhood [Weidinger et al., 2008].

Occupational asthma has been an acknowledged occupational disease in Denmark for several decades. In Denmark, an occupational disease can be reported to the National Board of Industrial Injuries by either the patient, by the patient's trade union, or by the patient's physician. Physicians are, however, obligated by law to report suspected occupational diseases to the Board [The Danish Ministry of Employment, 2009]. From 2000–2010, an average of 7.4 hairdressers had their asthma reported as an occupational disease annually (in all 81 cases) [The National Board of Industrial Injuries, 2011]. Of these, 56 cases (69.1%) answered were recognized as being occupational by the National Board of Industrial Injuries. On average, occupational rhinitis was reported 6.5 times annually by hairdressers (in all 72 cases) [The National Board of Industrial Injuries, 2011], and 69.4% were recognized as being occupational.

In Denmark the title hairdresser is not protected, i.e., anybody may practice as and call themselves a hairdresser. The government supports a 4-year vocational hairdressing school. There is training in health and safety during vocational school, but only of short duration and not updated.

Private hairdressing schools exist but they are not part of this study. There are no official statistics of the number of students finishing at private schools, but they are much fewer than those finishing the governmental supported training programs which are free.

In 1992, The Danish Hairdressers' and Beauticians' Union and The Danish Organization for Independent Hairdressers and Cosmeticians (formerly The Danish Hairdresser Association) decided to make local exhaust ventilation mandatory for all hairdressing salons. The Danish Working Environment Authority supported this decision with a guideline [The Danish Working Environment Authority, 2011]. If a hairdressing salon is not equipped with a proper local ventilation exhaust even though, for example, hydrogen peroxide is used, the national authorities may issue a fine to the salon owner.

The current study was performed in collaboration with the Danish Hairdressers' and Beauticians' Union and The Danish Organization for Independent Hairdressers and Cosmeticians. These organisations are responsible for collecting the names of persons who have finished the 4-year government supported

vocational hairdressing training. Results from the study concerning occupational skin exposure, the prevalence of hand eczema, its career consequences, and whether it was reported to the authorities as an occupational disease have previously been published [Lysdal et al., 2011; Lysdal et al., 2012a,b].

The aims of this study were to assess the prevalence of self-reported asthma and respiratory symptoms among hairdressers in Denmark and to describe to what extent these disorders are being reported as occupational diseases to the authorities. Additionally, this study provides a description of the self-reported use of local exhaust ventilation among hairdressers in Denmark.

MATERIALS AND METHODS

Design

We conducted a register based questionnaire study with a self-administered postal questionnaire among hairdressers in Denmark.

By combining information from registers with answers from a questionnaire we were able to get a great picture of the asthma prevalence status among trained hairdressers whether they were still in the trade or not.

In order to perform this study information from several registers was used. The Danish Hairdressers' and Beauticians' Union (representing the employees) and the Danish Organisation for Independent Hairdressers and Cosmeticians (representing the employers) have a joint committee that administers all diplomas issued for hairdressers trained at public hairdressing vocational schools. This joint committee provided information (name, Central Person Registration (CPR) number and year of graduation) on all the graduates. The CPR number is a unique identification number that has been issued to every resident in Denmark since 1968. The CPR number is issued at birth or upon receiving right to residency, and contains information on the person's sex and birth date (date, month and year). Based on the CPR number of every hairdressing graduate, information on vital status and current postal address was provided from the CPR Office. In addition, the Labour Market Supplementary Pension Scheme (the ATP register) provided information on annual affiliation to the hairdressing trade for every individual in the cohort. The Labour Market Supplementary Scheme is a mandatory Danish pension scheme where all employers have to pay a monthly contribution for every employee above the age of 16 years. Each trade has a unique code. By using these three registers we could contact all trained hairdressers at their correct address and check if they were in the trade or not. The study was approved by the Danish Data Protection Agency (00109 GEH-2008-08).

Study Population

The study population comprised all graduates from hairdressing vocational schools in Denmark between 1985–2007 whose current postal addresses were available from the Civil Registration System ($n = 7,840$). The only exclusion criteria were emigration or death. Thus the study population reflected the hairdressing population in Denmark regardless of sex, age, ethnicity, geographic distribution or affiliation to hairdressing unions. They received a postal questionnaire in May 2009 and two reminders.

Questionnaire and Definitions

The respondents completed a questionnaire consisting of 147 questions concerning topics of both occupational and personal nature. Asthma was defined as an affirmative answer to the question: ‘Has a physician ever told you that you have asthma?’ (‘yes’ vs. ‘no’). All respondents who believed that their asthma was caused or worsened by their occupation were asked to state whether their asthma was reported as an occupational disease to the National Board of Industrial Injuries (‘yes’, ‘no’ or ‘I don’t know’). In the event that the respondent did not confirm that a report had been made, the respondent was asked to tick off the reasons for not reporting. Atopic dermatitis was defined by the U.K. Working Party’s diagnostic criteria [Williams et al., 1994; Williams et al., 1996].

Smoking was defined by one of the six possible answers to the question: ‘Do you smoke?’ The answers were pooled into the following four categories: (I) ‘Daily smokers’ (‘I smoke daily’), (II) ‘Occasional smokers’ (‘I do not smoke every day’, ‘I am a social smoker’, ‘I am not a smoker, but I do smoke once in a while’), (III) ‘Ex-smokers’ (‘I do not smoke anymore’), and (IV) ‘Never smokers’ (‘I have never smoked’).

The exact phrasing of the questions used in this study is given in Tables I–VI. The questionnaire was developed at the Research Centre for Hairdressers and Beauticians by the chief investigator. Some of the questions were a further development of an earlier questionnaire [Hansen and Søstved, 2009]. It was pre-tested among supervisors of the project, the two hairdressing unions and experts in the fields of smoking and alcohol. The pilot test included 19 hairdressers, who received a postal questionnaire and who were subsequently interviewed by telephone. Aspects such as comprehension, ease of completion, relevance, lay-out, and time spent answering the questionnaire were commented upon. The questionnaire was adjusted accordingly.

The population finally included 5,239 respondents would did not necessarily answer all the questions. In order to determine the prevalence of self-reported occupational asthma, the whole population of trained hairdressers with self-reported asthma (consisting of both current hairdressers and ex-hairdressers) was asked: “Do you believe that your asthma is caused or worsened by your job?” (no time period specified). Even though the entire questionnaire consisted of questions concerning hairdressing we realize that ex-hairdressers may have interpreted the question as referring to their current occupation.

Statistics

All statistical analyses were carried out using the PASWTM Statistics 18 (SPSS Inc., Chicago, IL) for WindowsTM. A P -value of <0.05 was considered significant. The χ^2 trend test (univariate analysis) was used to test for statistically significant differences. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to describe the associations.

TABLE I. Self Reported Respiratory Tract Symptoms in Trained Hairdressers

	Hairdressers without asthma*	Hairdressers with childhood onset asthma	Hairdressers with adulthood onset asthma	All hairdressers
	N = 4,802	N = 157	N = 359	N = 5,318
	Total (%)	Total (%)	Total (%)	Total (%)
Q: Have you been woken by an attack of shortness of breath at any time in the last 12 months?				
Yes	244 (5.1)	34 (21.7)	116 (32.3)	394 (7.4)
Q: While working as a hairdresser apprentice and/or a hairdresser, have you ever experienced any of the following respiratory tract symptoms by being in the salon? Please tick any symptom that you have experienced.				
Cough	1095 (22.8)	56 (35.7)	194 (54.0)	1345 (25.3)
Nasal congestion	1077 (22.4)	49 (31.2)	150 (41.8)	1276 (24.0)
Rhinitis	791 (16.5)	41 (26.1)	137 (38.2)	969 (18.2)
Rhinorrhea	553 (11.5)	34 (21.7)	100 (27.9)	687 (12.9)
Shortness of breath	398 (8.3)	39 (24.8)	158 (44.0)	595 (11.2)

The respiratory symptoms reported are arranged in sequence of descending order (for all hairdressers). Multiple answers were possible.

χ^2 test for trend yields a p -value of <0.0001 across the three groups for all respiratory tract symptoms described.

*Includes missing.

RESULTS

Respondents and Non-Respondents

Answers were obtained from 5,324 out of 7,840 persons, giving a response rate of 67.9%. There was a significantly higher proportion of men in the group of non-respondents (8.8%) than in the group of respondents (4.3%) (OR 2.16; CI 1.78, 2.61). There was no significant mean age difference between the group of non-respondents (36.7 years) and the group of respondents (37 years) (95 percent confidence interval [95% CI] for the mean difference -0.62 , 0.50).

Only respondents who provided information on current occupation were included in the analysis giving a sample of 5,239 individuals aged between 22–65 years. A total of 2,321 (44.3%) did not work as a hairdresser anymore (ex-hairdressers) while 2,918 (55.7%) still worked in the trade (hairdressers). The group of hairdressers was similar to that of ex-hairdressers regarding sex: both groups consisted of 4.3% male and 95.7% female participants. The mean age of the hairdressers and ex-hairdressers was 36.4 years and 37.7 years, respectively (95% CI for the mean difference -1.62 , -0.98).

According to data from the Labour Market Supplementary Pension Scheme (ATP), the proportion of ex-hairdressers among the non-respondents was 70.3%. Thus, significantly more non-respondents than respondents no longer worked in the hairdressing trade (OR 2.97, 95% CI 2.69, 3.29).

Prevalence of Self-Reported Respiratory Tract Symptoms

The respiratory tract symptoms most frequently reported when being in the salon were coughing (25.3%), nasal congestion (24.0%), and rhinitis (18.2%) (Table I).

When divided into three subgroups ([i] hairdressers without asthma, [ii] hairdressers with childhood onset asthma, and [iii] hairdressers with adulthood onset asthma), it became evident that the group of hairdressers with adulthood onset asthma reported all types of respiratory tract symptoms to a significantly higher extent than the other groups (χ^2 test for trend: $P < 0.0001$, Table I). Figure 1 is a flow chart of the study population showing the distribution of asthma among current and former hairdressers.

Prevalence of Self-Reported Asthma

The overall prevalence of self-reported asthma in all hairdressers was 11.2%. Significantly more of the ex-hairdressers reported asthma than did current hairdressers (Table II). The majority (62.5%) of the respondents with self-reported asthma were 16 years old or older at asthma debut (adulthood onset asthma). The mean age at asthma onset for this group was 26.9 years (range 16–57 years).

In total, 39.3% of the respondents with adulthood onset asthma had had an asthma attack within the past 12 months, and 46.4% were taking asthma medicine at the time of answering the questionnaire (Table II). No significant differences were found between ex-hairdressers and current hairdressers regarding the one year prevalence of asthma attacks and the use of asthma medicine (Table II).

In a previous publication we found that 6.1% (124/2,038) of all ex-hairdressers (regardless of asthma status) left the hairdressing trade because of asthma [Lysdal et al., 2011]. In this study among ex-hairdressers with adulthood onset asthma, 44.8% (82/183) reported asthma as a reason for leaving the trade, while this was true for 23.2% (16/69) of the ex-hairdressers with childhood onset asthma (OR: 2.69; CI [1.43–5.05]).

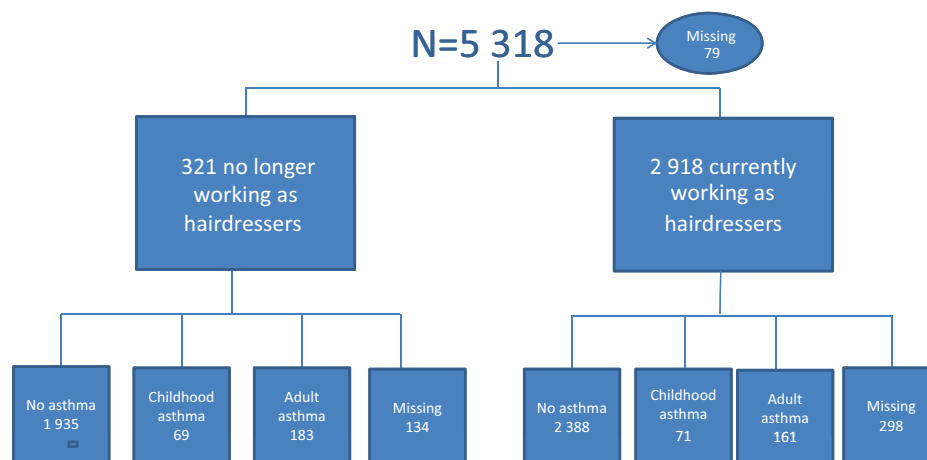


FIGURE 1. Flow chart of study population. The number of ex-hairdressers is taken from a previous publication, Lysdal et al., 2011. The number of hairdressers currently working in the trade is from Table V.

TABLE II. Self Reported Asthma Among Current Hairdressers and Ex-Hairdressers

	Ex-hairdressers N = 2,321 Total (%)	Current Hairdressers N = 2,918 Total (%)	All hairdressers N = 5,239 Total (%)	OR (CI)
Q1: Has a doctor ever told you that you have asthma?	N = 2218	N = 2897	N = 5115	
Yes	283 (12.8)	290 (10.0)	573 (11.2)	1.32 (1.10–1.56)
No	1935 (87.2)	2607 (90.0)	4542 (88.8)	
Q2: Have you had an attack of asthma in the last 12 months?	N = 181	N = 175	N = 356	
Yes	68 (37.6)	72 (41.1)	140 (39.3)	0.86 (0.56–1.32)
No	113 (62.4)	103 (58.9)	216 (60.7)	
Q3: Are you currently taking any asthma medicine (e.g., inhalator, spray or pills?)	N = 183	N = 175	N = 358	
Yes	79 (43.2)	87 (49.7)	166 (46.4)	0.77 (0.51–1.17)
No	104 (56.8)	88 (50.3)	192 (53.6)	
Q4: Do you think that your asthma is caused or worsened by your job*	N = 129	N = 134	N = 263	
Yes	91 (70.5)	59 (44.0)	150 (57.0)	3.04 (1.83–5.07)
No	38 (29.5)	75 (56.0)	113 (43.0)	
Q5: Has your asthma been reported as an occupational disease?	N = 91	N = 59	N = 150	
Yes	36 (39.6)	7 (11.9)	43 (28.7)	4.86 (1.99–11.89)
No	55 (60.4)	52 (88.1)	107 (71.3)	

For questions 2–5, answers are only reported for respondents with adulthood onset asthma (asthma onset above the age of 16 years) (N = 358).

CI, confidence interval; OR, odds ratio. Significant association is shown in bold.

*Time period not specified.

Report of Asthma as an Occupational Disease to the Authorities

A total of 57.0% of the respondents with adulthood asthma suspected their asthma to be caused or worsened by their occupation (Table II). This was true for significantly more ex-hairdressers (70.5%) than current hairdressers (44.0%) (Table II).

Only 28.7% of the respondents who suspected their asthma to be caused or worsened by their occupation had had their asthma reported as an occupational disease to the authorities. Notably, this was true for significantly more ex-hairdressers (39.6%) than current hairdressers (11.9%) (Table II). The most frequently reported reason for not reporting asthma as an occupational disease among respondents, who suspected their asthma to be caused or worsened by their occupation, was 'My doctor did not tell me it was possible to report it' (38.4%). (See Table III).

Atopic Dermatitis

In all, 23.7% of the ex-hairdressers and 21.0% of the current hairdressers had atopic dermatitis according to the UK criteria (OR: 1.17; CI [1.03–1.34]).

Among all respondents with asthma (n = 573), 58.8% had atopic dermatitis (OR 6.41; CI [5.35–7.68]). The proportion of respondents with atopic dermatitis did not differ significantly among respondents with childhood onset asthma (59.1%) and those with adulthood onset asthma (57.9%) (OR: 0.95; CI [0.65–1.39]).

Respiratory Reaction due to Contact With Hair Bleaching Products

A respiratory reaction (shortness of breath and/or difficulty breathing) due to contact with hair bleaching products was experienced by 27.1% of all trained hairdressers (Table IV).

Significantly more ex-hairdressers had ever experienced a respiratory reaction to hair bleaching products (644/2,132 or 30.2%) than had current hairdressers (17.6%) OR: 2.02; 95%; CI [1.77–2.31]). A reaction to hair bleaching products was significantly more common among hairdressers with adulthood onset asthma (57.5%) than among hairdressers with childhood onset asthma (38.1%), and hairdressers without asthma (24.4%) χ^2 test for trend: $P < 0.0001$, Table IV).

TABLE III. Reasons for not Reporting Asthma as an Occupational Disease to the Occupational Registers Among 258 Hairdressers who Believed Their Asthma was Caused or Worsened by Their Job

	All hairdressers N = 258 Total (%)
Q: Why has your asthma not been reported as an occupational disease?	
My doctor did not tell me it was possible to report it.	99 (38.4)
I did not know that my asthma was occupational	90 (34.9)
Other*	49 (19.0)
I would probably not gain anything from it anyway	42 (16.3)
I thought it would eventually get better	40 (15.5)
I have always had asthma	28 (10.9)
It seemed difficult	23 (8.9)
My doctor did not think that my asthma was occupational	19 (7.4)
I am self-employed and not insured	14 (5.4)
It had gone over the time limit	7 (2.7)
I was worried it would lead to problems with my employer	3 (1.2)
I was afraid to lose my job	3 (1.2)

Multiple answers were possible.

*Other served as the last response category in the question asked. Respondents, who checked off this category had the opportunity to add a written comment. The comments were mainly a repetition of some of the categories already given or described the asthma as having "passed".

Local Exhaust Ventilation

Among all hairdressers currently working in the trade, 90.3% reported that local exhaust ventilation was in the salon in which they worked (2,620/2,903). Thus 9.7% of hairdressers do not have local exhaust ventilation in the salon where they work.

Among hairdressers who have local exhaust ventilation in the salon where they work, only 63.2% used it consistently

TABLE IV. Shortness of Breath and Difficulty Breathing due to Contact With Hair Bleaching Products

	Hairdressers without asthma N = 4,784 Total (%)	Hairdressers with childhood onset asthma N = 160 Total (%)	Hairdressers with adulthood onset asthma N = 374 Total (%)	All hairdressers N = 5,318 Total (%)
Q: Have you ever experienced having difficulty breathing or shortness of breath elicited or exacerbated by contact with hair bleaching products? Please tick one box only.				
Yes	1165 (24.4)	61 (38.1)	215 (57.5)	1441 (27.1)
No	3619 (75.6)	99 (61.9)	159 (42.5)	3877 (72.9)

χ^2 test for trend across asthma categories: $P < 0.0001$.

for permanent waving and hair coloring procedures regardless of their asthma status (Table V). This was true for significantly more hairdressers with adulthood onset asthma (69.6%) than hairdressers with childhood onset asthma (54.9%) (OR: 1.87, 95%; CI [1.05–3.34]). In all, 8.2% of the hairdressers never used local exhaust ventilation for permanent waving and hair coloring procedures (Table V). No difference between hairdressers with and without asthma was observed in this regard.

Local exhaust ventilation was used for mixing hair dye by 41.3% of all hairdressers; however, more than one third of all hairdressers (34.1%) never used local exhaust ventilation for this procedure regardless of their asthma status (data not shown).

Smoking

In all, 38.6% of the hairdressers were smokers; 27.3% were daily smokers and 11.3% were occasional smokers. A total of 25.8% were ex-smokers and 35.7% of the hairdressers had never smoked. With the exception of the group

TABLE V. Use of Local Exhaust Ventilation, When Available, Among Current Working Hairdressers With and Without Asthma

	Hairdressers without asthma N = 2,388 Total (%)	Hairdressers with childhood onset asthma N = 71 Total (%)	Hairdressers with adulthood onset asthma N = 161 Total (%)	All hairdressers N = 2,620 Total (%)
Q: Do you use local exhaust ventilation for permanent waving and hair coloring procedures?				
Yes, every time	1506 (63.1)	39 (54.9)	112 (69.6)	1657 (63.2)
Yes, but not every time	678 (28.4)	29 (40.8)	40 (24.8)	747 (28.5)
No, never	204 (8.5)	3 (4.2)	9 (5.6)	216 (8.2)

χ^2 test for the 3×3 subgroup comparison: $P = 0.05$.

TABLE VI. Smoking Among Trained Hairdressers in Denmark

Smoking	Ex-hairdressers N = 2,303 Total (%)	Hairdressers N = 2,896 Total (%)	All hairdressers N = 5,199 Total (%)	OR (CI)
Daily smokers	646 (28.1)	772 (26.7)	1418 (27.3)	1.08 (0.95–1.22)
Occasional smokers	254 (11.0)	331 (11.4)	585 (11.3)	0.96 (0.81–1.14)
Ex-smokers	624 (27.1)	718 (24.8)	1342 (25.8)	1.12 (0.99–1.28)
Never smokers	779 (33.8)	1075 (37.1)	1854 (35.7)	0.86 (0.81–0.97)

Smoking among trained hairdressers in Denmark defined by the answers to the question: Do you smoke? The respondents could tick one of the following categories: (I) I smoked daily, (II) I do not smoke every day, (III) I am a social smoker, (IV) I am not a smoker, but I do smoke once in a while, (V) I do not smoke anymore, and (VI) I have never smoked. Categories II–IV were merged into the category Occasional smokers.

CI, confidence interval; OR, odds ratio. Significant association is shown in bold.

of “Never smokers” there were no significant differences in smoking habits between current hairdressers and ex-hairdressers (Table VI).

Hairdressers with self-reported asthma (N = 573) did not differ significantly from the group of hairdressers without asthma with regard to smoking: 26.0% were daily smokers, 10.0% were occasional smokers, 29.0% were ex-smokers, and 35.0% were never smokers.

DISCUSSION

While working, hairdressers are exposed to a broad range of chemicals that are released into the air and that may potentially cause asthma and respiratory symptoms. Thus asthma is a known occupational disease in hairdressers [Leino et al., 1997b; Venables and Chan-Yeung, 1997; Moscato et al., 2005]. Our study yielded a prevalence of self-reported physician based asthma of 11.2% among all trained hairdressers. A previous study performed by Leino et al. resulted in a similar prevalence [Leino et al., 1997b].

Atopic dermatitis is a risk factor for asthma [Weidinger et al., 2008], and since hairdressers have less atopic dermatitis than a matched controls [Bregnhøj and Sosted, 2009], they should have less asthma than matched controlled if they were not exposed to environmental risk factors.

The mean age of developing adulthood asthma was 26.9 years for the hairdressers participating in this study. Thus, as opposed to occupational hand eczema which has a very early onset age [Lysdal et al., 2011], asthma, if occupational, seems to develop after several years of working in the hairdressing trade. This has been observed in previous studies as well [Albin et al., 2002; Munoz et al., 2004; Moscato et al., 2005].

Cough, nasal congestion, and rhinitis as a consequence of being in the salon were commonly reported among the hairdressers in our study. These findings are in alignment with previous studies which have found these respiratory symptoms to be significantly more prevalent in hairdressers than in other occupational groups [Leino et al., 1997a;

Hollund and Moen 1998] and the general population [Brisman et al., 2003].

As rhinitis and asthma can be looked upon as manifestations of airway hyperreactivity in two parts of the respiratory tract, and rhinitis can be a precursor of asthma [Togias, 2003], even mild rhinitis symptoms should be taken seriously in order to avoid further evolution of the condition. Notably, all the respiratory symptoms presented in this study were reported significantly more often by hairdressers with asthma; especially among hairdressers with adulthood onset asthma.

The majority of the hairdressers had developed their asthma after the age of 16 years (62.7%). This makes the exposure in the hairdressing trade a plausible cause of their asthma since training usually starts after the age of 16 years. Persulfates are found in high concentrations in hair bleaching products and they are known to cause asthma and respiratory symptoms in hairdressers [Blainey et al., 1986; Leino et al., 1998; Cruz et al., 2009]. In our study, 27.1% of all hairdressers reported having experienced difficulty in breathing or shortness of breath due to contact with hair bleaching products. Among respondents with adulthood onset asthma this was even more pronounced, with 57.5% reporting these symptoms.

The ex-hairdressers were three times more likely to suspect a causal relation between their occupation and their asthma than did the current hairdressers. Additionally, the ex-hairdressers were almost five times more likely (OR 4.86) to have reported their asthma as an occupational disease than the current hairdressers were (Table II), and had more commonly experienced a respiratory reaction due to contact with hair bleaching products than the current hairdressers had. Moreover, almost half of the ex-hairdressers with adulthood onset asthma reported having left the trade because of asthma. These findings indicate that hairdressers with asthma of lesser severity, and who tolerate the occupational exposures, continue to work in the profession, whereas the strongly affected individuals are selected out and more often have to leave the hairdressing

trade because of it [Leino et al., 1997a; Albin et al., 2002; Hollund et al., 2003].

When discussing causes of asthma and respiratory symptoms, smoking must be considered. In Denmark in 2005–2010, 19.3% of the female population smoked on a daily basis [The National Board of Health, 2011]. Thus the proportion of daily smokers among the hairdressers is higher (27.3%) than in the general population. Additionally, the proportion of never smokers among the hairdressers (35.7%) is considerably smaller than among the general female population (49.9%) [The National Board of Health, 2011].

Surprisingly, we found no difference in the smoking pattern among respondents with asthma and respondents without asthma. However, the limited amount of data collected on smoking does not allow a detailed analysis of the smoking pattern.

For almost 85% of hairdressers with hand eczema, the causal relation between hand eczema and the hairdressing trade is evident [Lysdal et al., 2012a]. By contrast, only 57% of the hairdressers with adulthood onset asthma suspected a causal relation between their trade and their asthma. As a consequence, more than 1/3 of the hairdressers either never use local exhaust ventilation for mixing procedures, and/or use it inconsistently when applying hair dyes and permanent wave solutions. This may also be the reason for the underreporting, by 71.3%, of asthma as an occupational disease to the National Board of Industrial Injuries found in our study. Consequently, the true number of occupational asthma cases among hairdressers is likely to be considerably higher than that reflected by the national registers, and a similar tendency of substantial underreporting of occupational rhinitis would be expected.

Occupational asthma and respiratory symptoms among hairdressers are largely preventable and thus primary preventive actions in hairdressing salons need to be carried out. These include implementation of adequate ventilation systems in all salons as this significantly decreases the exposure level of airborne chemicals [Hollund and Moen, 1998]. Further, respiratory symptoms and asthma due to persulfates can be relieved by changing to a non-powdered persulfate formula such as granulates or cream [Albin et al., 2002; Bregnhøj and Sosted, 2009]. Even though cross reactivity can occur [Aalto-Korte and Makinen-Kiljunen, 2003], substitution of ammonium persulfate may be of relevance as some hairdressers may tolerate products containing potassium sulfate even if they cannot tolerate ammonium persulfate [Bregnhøj and Sosted, 2009].

However, hairdressers are not only exposed to persulfates but to a complex mixture of airborne chemicals on a daily basis. This leads us to hypothesize, in line with previous studies [Hollund and Moen, 1998; Albin et al., 2002; Munoz et al., 2004; Moscato et al., 2005], that asthma and respiratory symptoms among hairdressers are caused not only by persulfates. As the total mixture of airborne chemicals can

reach significant concentrations, especially on very busy days [Labreche et al., 2003] symptoms may also be caused by the many other irritating and potentially sensitizing factors such as dust, vapors, perfumes, hair dyes, hair sprays, and other volatile solvents [van Muiswinkel et al., 1997; Albin et al., 2002].

In conclusion, this study shows that asthma and respiratory symptoms are frequent among hairdressers and that there is a significant underreporting of asthma as an occupational disease to the authorities. Consequently, our results underline the need for substitution of harmful products and implementation of adequate local exhaust ventilation systems in hairdressing salons. Additionally, awareness of asthma and respiratory symptoms in the hairdressing trade needs to be raised among both hairdressers and physicians so that an occupational etiology is always considered when diagnosing asthma and respiratory symptoms in hairdressers.

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