

Risk Factors for Asthma Among Cosmetology Professionals in Colorado

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Problem: After receiving several reports of occupational asthma among cosmetology professionals, we studied the prevalence, work-attributable risk, and tasks associated with asthma in this industry.

Methods: We selected a stratified random sample of cosmeticians, manicurists, barbers, and cosmetologists holding licenses in Colorado for a mail survey instrument. **Results:** The prevalence of physician-diagnosed asthma among the 1883 respondents (68% response rate) was 9.3%; of these, 67 (38%) developed asthma after entering the cosmetology profession. Multivariate analyses showed that hairstyling, application of artificial nails, and shaving and honing were significantly associated with asthma arising in the course of employment ($P < 0.005$) with relative risks of 2.6–2.9. **Conclusions:** The increased risk of asthma with onset during employment among cosmetologists is probably attributable to their exposure to sensitizers and irritants in tasks demonstrated to be associated with asthma. (J Occup Environ Med. 2006;48:1062–1069)

Occupational asthma occurs among cosmetology workers with several different sensitizing exposures: persulfate salts contained in hair bleaches,^{1–3} henna,⁴ monoethanolamine in hair set lotion, ammonium thioglycolate in wave set lotion, ethylenediamine as a stabilizer in lacquers, and hexamethylenetetramine in hair spray.⁵ Apart from sensitizing chemicals associated with immunologically mediated lung disease, workers in this field are exposed to irritants and odiferous substances, which can exacerbate underlying asthma, whether occupational or nonoccupational in origin.⁶ Alcohols have also been considered to be markers of exposure to volatile compounds of hairdressing operations.⁷ In addition, hair spray has been associated with both acute and chronic respiratory symptoms and obstructive pulmonary functions and may cause the granulomatous lung disease, thesaurosis.^{8–12} A case-control study demonstrated that hairdressers were overrepresented 4.4-fold among cases of idiopathic pulmonary fibrosis compared with controls.¹³ Granulomatous and fibrotic lung disease in cosmetology professionals are potential causes of airways hyperreactivity or chest symptoms, which could be misclassified as asthma.

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Data are evolving that estimate the risk of asthma in the cosmetology field. Blainey et al found four cases of persulfate asthma among 11 tinters who mixed bleach powders in a salon employing 23 workers.¹ In a cross-sectional study for thesaurosis, Palmer et al showed that working cosmetologists had a 10% increased prevalence of respiratory symptoms compared

with a control group of retail clerks, telephone company employees, and medical and dental assistant students.⁹ In Sweden, female hairdressers had a standardized mortality ratio of 332 for asthma.¹⁴ Finnish hairdressers were 3.5 times more likely to leave the profession because of asthma or hand eczema than a control group.¹⁵ The most compelling works on risk of asthma among hairdressers show increased risk of upper and lower respiratory symptoms with adjusted odds ratios of 1.4 to 1.9¹⁶ and a 1.7-fold risk of developing physician-diagnosed asthma over a 15-year follow up in comparison with saleswomen.⁶ More recently, asthma or respiratory symptoms have been described in hairdressers in New Zealand,¹⁷ Norway,¹⁸ Turkey,¹⁹ and Sweden.^{20,21}

Between late 1987 and 1990, the Colorado Department of Health and Environment received five reports of occupational asthma in cosmetology professionals in a surveillance project,²² which received 120 reports of occupational asthma during that period. The cosmetology field consists of four subgroups of licensees who focus on different services. Two of the five cases worked exclusively in the application of artificial nails. We investigated the prevalence of asthma and respiratory complaints among workers in the cosmetology field with attention to the work-related risk factors associated with the development and exacerbation of asthma. Task-related risk factors allow exploration of the proportion of asthma attributable to work and are a means of targeting future preventive actions. Our design allowed estimation of considerable healthy worker effect among subgroups in the cosmetology field, which is not evident in previous cross-sectional studies of single subgroups.

Materials and Methods

Population

The Colorado Board of Cosmetology had licensed 27,859 Colorado residents as cosmetologists, barbers,

manicurists, or cosmeticians as of February 1, 1991. We constructed a random sample of 3035 licensees (without regard to active employment) from the licensing board's list stratifying the sample to select 900 cosmetologists, 900 barbers, 900 manicurists, and all 335 cosmeticians based on practical considerations. These license categories differ in educational requirements, with cosmetologists licensed to perform the services of the remaining categories apart from shaving, honing, and stropping (the traditional sharpening of razor blades for shaving) performed by barbers. Cosmeticians are authorized only to perform massage, skin care, makeup, and the application of low electrical currents, chemicals, and infrared and ultraviolet light to the skin. We mailed subjects a pretested questionnaire adapted from a standardized respiratory questionnaire²³ supplemented with questions regarding occupational history and work-related symptoms and medication use. Subjects not responding within 45 days were mailed a second questionnaire. A 10% sample of persistent nonrespondents ($n = 96$) was contacted for telephone interviews to increase the response rate. For the remaining nonrespondents ($n = 864$), we selected a 23% sample ($n = 200$, stratified equally by license category) for a postcard mail survey with six key questions followed by a second postcard to nonrespondents 15 days later.

We defined cases of asthma as those respondents reporting a physician diagnosis of asthma. We defined cases of asthma with onset after entering the cosmetology field as posthire asthma. Asthmatic respondents reporting asthma worse with workplace exposure or activities were classified as work-exacerbated. We classified the asthma subgroup requiring current asthma medication or treatment as active asthma.

Statistics

When comparing subgroups, we used Student *t* test for continuous

data and χ^2 and Fisher exact tests, as appropriate, for categorical data. We used logistic regression models to investigate asthma, work-exacerbated asthma, posthire asthma, and active asthma as a function of possible work-related risk factors; a backward selection procedure allowed us to select statistically significant independent variables. Independent variables included gender, age, smoking status at the time of onset of respiratory symptoms or diagnoses if present, license category, employment status, employment duration, and cosmetology services performed. We used Statistical Analysis Software (SAS version 8.02, 1999–2001; SAS Institute, Inc., Cary, NC) for all statistical analyses and chose a probability of 0.05 for statistical significance.

Results

Demographics

Of the 3035 questionnaires mailed, 2747 (90.5%) were delivered to addresses of cosmetology professionals. Among the deliverable surveys, 1787 of them were completed after the first or second mailing. With telephone interview data for an additional 96 respondents, we obtained an effective response rate of 68.5% (1883 of 2747). Response rates by license category varied from a low of 64% for barbers to a high of 78% for cosmetologists.

Of the 200 postcards mailed to nonrespondents, 182 were delivered to the addresses of cosmetology professionals, of which 138 (76%) were completed. Nonrespondents returning the abbreviated survey had a significantly higher prevalence of cough than respondents (28% vs 19%, $P = 0.03$) but did not differ significantly in wheezing apart from colds, wheezing most days or nights, self-reported asthma, cigarette smoking history, or current employment in the cosmetology field.

Participants grouped by license category differed significantly in mean age and gender with barbers being older and male (Table 1). Men in the study had smoked more com-

TABLE 1
Demographic Characteristics of Respondents by License Category

Characteristic	Cosmetologists (n = 623)	Cosmeticians (n = 190)	Manicurists (n = 524)	Barbers (n = 546)
Mean age in years	40.0	37.0	37.0	50.0
Male (%)	4.2	0.5	1.0	69.4
Ever smoker (%)	50.1	47.9	57.2	69.4
Current smoker (%)	28.2	29.0	29.6	26.6
Race (%)				
White/non-Hispanic	81.4	89.5	82.4	68.3
White/Hispanic	12.5	6.3	10.5	23.4
Currently employed (%)	48.6	59.5	46.0	54.8
Denver residents (%)	72.0	73.0	64.0	55.0

TABLE 2
Percent Respondents Reporting Cosmetology Services Provided ≥ 5 Times/Month by License Type

Services	Cosmetologists (n = 623)	Cosmeticians (n = 190)	Manicurists (n = 524)	Barbers (n = 546)
Haircut	87.0	4.7	2.7	95.8
Shampoo	81.9	4.2	3.8	53.7
Hairstyling	87.2	3.7	2.9	46.0
Perms	84.1	3.2	3.0	33.7
Basic manicuring	33.9	20.5	79.2	2.6
Bleach and tinting	74.5	4.7	2.3	28.2
Application of artificial nails	17.7	20.0	81.3	2.4
Massage and skin care	22.8	83.2	12.6	13.9
Shaving and honing	4.5	1.6	1.2	44.3
Electricity and chemistry	3.8	28.4	1.5	5.7

monly than women (72% vs 52%, $P = 0.0001$), although identical percentages (27%) were current smokers. The majority (79%) of the study population was non-Hispanic white with an additional 14% Hispanic, the remainder being other minorities. Most respondents (66%) resided in the Denver metropolitan area.

Despite holding active licenses, only 51% ($n = 956$) of respondents were currently employed in the cosmetology field at the time of our survey. The last or current employment was usually in a salon (81%) rather than at home. Of those who worked in salons, 75% were employed with four or fewer coworkers. Manicurists and cosmeticians had worked typically for ≤ 5 years (65.1% and 68.9%, respectively), whereas barbers and cosmetologists had usually worked for > 5 years (85.4% and 66.3%, respectively). Cosmetology services performed by respondents at least five times per

month in the last or current job differed by license category but did not strictly follow license authorization (Table 2).

Respiratory Symptoms

Prevalence rates for usual cough, wheezing most days and nights, and chest tightness most days and nights were significantly different among the subgroups of cosmetology professionals with cosmeticians being relatively spared (Fig. 1). Of the 40 subjects responding affirmatively to having a usual cough, wheezing most days or nights, chest tightness most days or nights, and having had an attack of wheezing that made them feel short of breath, only 47% reported having been diagnosed by a physician as having asthma and only 45% reported still having asthma.

Asthma Subtypes

Of the 175 (9.3%) respondents reporting ever having physician-

diagnosed asthma, 67 (3.6% of respondents and 38% of asthmatics) developed asthma after entering the cosmetology profession. Prevalences of posthire asthma differed in a non-significant way among license groups (4.8% among cosmetologists, 3.5% among barbers, 2.7% among manicurists, and 2.1% among cosmeticians; $P = 0.16$; Fig. 2). Work-exacerbated asthma was reported by 3.7% ($n = 69$) of subjects and was common among those with posthire asthma and uncommon among those who had developed asthma before entering the cosmetology field (68.4% vs 1.7%, $P < 0.0001$). Active asthmatics constituted 4.0% ($n = 76$) of the study population, and posthire asthmatics differed from other asthmatics in their need for current medication (69.6% vs 2%, $P = 0.0001$). Although cosmeticians had the highest prevalence of asthma acquired before entering the field, this group had a low rate of asthma

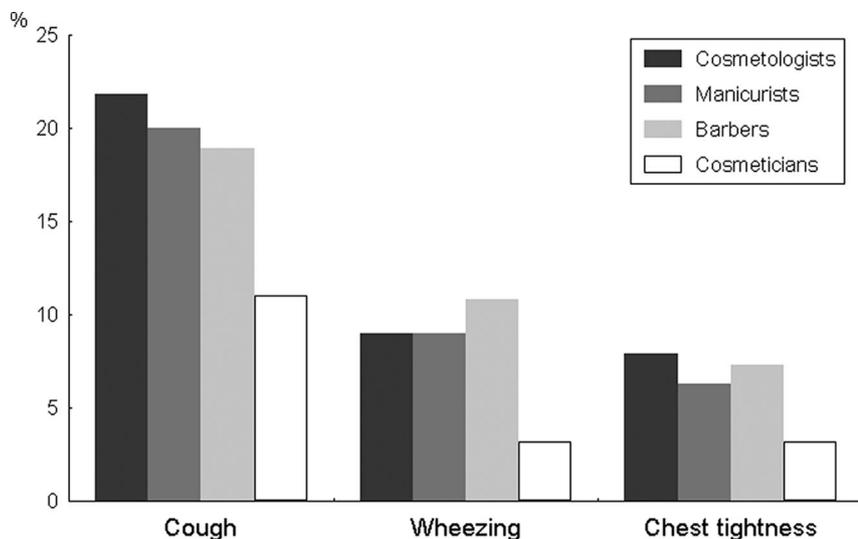


Fig. 1. Percent prevalence by license group for report of usually having a cough, wheezing most days/nights, and chest tightness most days/nights.

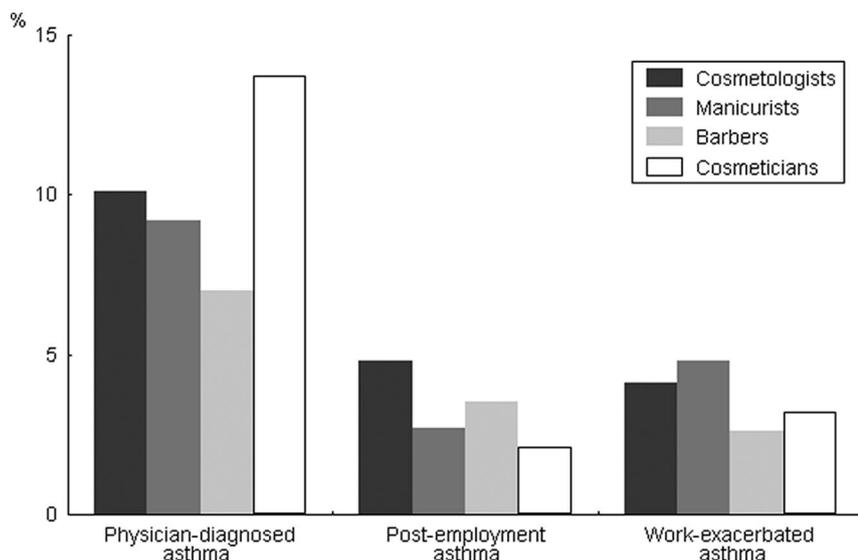


Fig. 2. Percent prevalence by license group of physician-diagnosed asthma, posthire asthma, and work-exacerbated asthma.

exacerbation with work exposures and activities.

Compared with men, women had significantly higher prevalences of asthma (10.3% vs 5.8%, $P = 0.006$), work-exacerbated asthma (4.5% vs 1%, $P < 0.0004$), and active asthma (7.1% vs 3.2%, $P = 0.003$); and a trend existed for women to have higher prevalence of posthire asthma. Prevalences of asthma, posthire asthma, work-exacerbated asthma, and active asthma did not differ significantly by age (grouped by decade) or by race/ethnicity (data not shown). Ever-

smokers had virtually identical prevalence of asthma compared with never-smokers (9.4% vs 9.2%). Posthire asthmatics were 1.4 ($P < 0.02$) times more likely to be current smokers at the time of diagnosis than nonasthmatics at the time the questionnaire was administered. Work-exacerbated asthma and active asthma cases did not differ significantly by smoking status at the time of diagnosis from other asthmatics.

Location of last or current employment was not associated with posthire asthma. The prevalence of

work-exacerbated asthma was 7.4% among those working at home and 3.3% among those employed in salons; the prevalence of asthma requiring current medication was 8.7% among those working at home and 3.6% among those employed in salons (data not shown).

Active employment in the cosmetology field was not significantly associated with prevalence of posthire, work-exacerbated asthma, or asthma requiring current treatment ($P = 0.46, 0.11, \text{ and } 0.92$, respectively). However, those with preexisting asthma, with preexisting attacks of wheezing with shortness of breath, or preexisting wheezing or chest tightness apart from colds tended to leave the cosmetology field at higher annual rates than those without such conditions, consistent with a healthy worker effect. The difference was strongest in the first 6 years of employment in the cosmetology field during which time workers with these conditions left with annual rates between 1.5 and 3.6 times the annual rates of those without such conditions. Workers with posthire respiratory disease also left at increased annual rates.

Duration of employment in the cosmetology field was not significantly associated with posthire asthma. Work-exacerbated asthma tended to be more frequent among those employed 5 years or less (4.6% vs 3.1%, $P = 0.1$). Active asthma was higher among those employed for no more than 5 years in the field (7.9% vs 5.2%, $P = 0.018$) consistent with a healthy worker effect.

Service-Related Risks

Although prevalences of the asthma subtypes of interest did not differ by license type in univariate analyses, several services in the cosmetology field were independently associated with asthma outcomes in logistic regression modeling (Table 3): For posthire asthma, hairstyling, application of artificial nails, and shaving and honing conferred significantly elevated relative risks of 2.93, 2.83,

TABLE 3

Final Model for Backward Logistic Regression Analysis of Posthire Asthma Risk Factors

Variables	P	Relative Risk	95% Confidence Interval
Application of artificial nails	0.0002	2.83	1.64–4.88
Hairstyling	0.0001	2.93	1.70–5.05
Shaving and honing	0.0014	2.60	1.44–4.68

and 2.60, respectively, in comparison to never having performed these services. These three services also were independently associated with work exacerbation of asthma with application of artificial nails conferring a 3.3-fold risk. In addition, massage and skin care conferred excess risk (data not shown).

Health-Related Change in Employment

License subgroups differed significantly in rates of leaving cosmetology because of health problems acquired while working in the cosmetology field ($P < 0.001$) and because of health problems involving asthma, other respiratory symptoms, or allergies ($P < 0.006$) (Table 4). High proportions of cosmetologists (15.7%) and manicurists (12%) had

left employment in the field (while retaining their licenses) for health problems often of a respiratory, allergic, or dermatologic nature.

Of cosmetologists who had left because of health problems acquired or exacerbated on the job, 19% left the field because of respiratory illness or asthma, and 33.6% left the field for these conditions or unspecified allergies, symptoms of which often accompany occupational asthma.^{1,19} Nearly one in 20 cosmetologists (4.6%) had left cosmetology because of respiratory illness or asthma acquired while working in cosmetology in contrast to 1.5% of cosmeticians and 2.0% of barbers ($P < 0.001$). An additional 2.4% of cosmetologists had left the field because of respiratory illness or asthma acquired before entering the field but

worsened while working in cosmetology. In contrast, only 1% of cosmeticians and 0.4% of barbers had left the field because of exacerbation of preexisting respiratory illness or asthma ($P < 0.001$). Among those cohort members leaving the cosmetology field because of asthma acquired while working, their independent odds of having performed hairstyling, application of artificial nails, or massage and skin care were 2.6, 1.2, and 1.6, respectively, when compared with those not leaving the cosmetology field.

Discussion

This stratified random sample survey of nearly 2000 cosmetology licensees in Colorado showed that application of artificial nails, hairstyling, and shaving and honing each increased the risk of developing asthma during employment between 2.5- and 3-fold compared with persons in the field who had never performed these services. Although asthma affects only a small proportion of cosmetology professionals, 7.0% of cosmetologists had left employment in the field in which they held licenses because of respiratory illness or asthma acquired or exacer-

TABLE 4

Percent of Respondents Who Left Field Because of Health Problems by License Type

	Cosmetologists (n = 623)	Cosmeticians (n = 190)	Manicurists (n = 524)	Barbers (n = 546)
Health problems acquired on the job	15.7	4.7	12.0	7.9
Respiratory illness*	3.2	1.0	2.5	1.1
Asthma	1.4	0.5	0.6	0.9
Headache	1.6	1.0	3.2	0.2
Unspecified allergy	2.6	0.5	2.1	0.7
Skin	3.7	0.0	1.5	0.7
Back	0.9	2.6	1.3	1.6
Carpal tunnel	0.4	0.5	0.4	0.0
Unspecified	1.3	2.6	1.3	1.6
Health problems exacerbated on job	4.6	1.6	3.4	3.8
Respiratory illness	1.3	0.5	1.3	0.2
Asthma	1.1	0.5	0.6	0.2
Headache	0.3	0.0	0.7	0.0
Unspecified allergy	1.4	1.0	0.8	0.0
Skin	0.5	0.0	0.2	0.2
Back	0.3	0.0	0.0	0.4
Carpal tunnel	0.2	0.0	0.0	0.2
Unspecified	0.4	1.0	0.2	0.4

*Primarily shortness of breath or frequent respiratory infections as coded from written responses.

bated during employment. That work-related factors are related to this experience is suggested by the much lower rates among other license groups whose services differ from those provided by cosmetologists. In fact, the services associated with leaving cosmetology employment because of asthma or respiratory illness included two of the three high-risk services: application of artificial nails and hairstyling.

Limitations

Although we had the benefit of many hundred respondents in license subgroups, mail surveys such as ours are limited in their representativeness by possible response bias. Fortunately, a random sample of nonrespondents did not differ from respondents in wheezing or reported asthma. Indeed, nonrespondents had a significantly higher rate of cough, making it unlikely that our respondents overreported respiratory symptoms and disease compared with other licensed cosmetology professionals. On the other hand, our documentation that some licensees had left cosmetology field employment for health reasons raises the concern that this cross-sectional study may have underestimated the respiratory health impact of this work, because similar persons might have let their licenses lapse and thereby would not have been available for survey. We have no way of assessing this potential selection bias (a "healthy licensee" effect) in our cross-sectional survey, although our design minimized this effect compared with cross-sectional studies of active workforces. Certainly, Iwatubo et al demonstrated a strong healthy worker effect among hairdressing apprentices in France, related to the early deterioration of lung function in these workers, compared with a control population of office apprentices.²⁴

In analyzing physician-diagnosed asthma cases, we likely underestimated rates of asthma that would be found with clinical diagnostic measures of airway hyperreactivity or

peak expiratory flow logs. Our respiratory symptom prevalence data suggest that only approximately half of respondents with a current symptom complex suggestive of asthma had a physician diagnosis. We do not know whether these persons have not sought medical care for these symptoms or whether physician diagnostic practices vary considerably.

Manicurists

Our findings of occupational asthma cases and excess risk of asthma among applicators of artificial nails are not surprising, because acrylates and cyanoacrylate glues have been associated with occupational asthma in other industries.²⁵ Artificial nails are applied with two general methods: sculptured nails and preformed tips. Sculptured acrylic nails are formed over the natural nail by using a liquid acrylic monomer and a powdered methacrylate polymer, which may contain a peroxide accelerator. The powder and liquid are mixed to form a plastic paste, which cures after it is smoothed onto the natural nail. Similar systems exist to build sculptured nails from porcelain powder (formerly containing methyl methacrylate) or from gel systems in which resins harden when exposed to ultraviolet or visible light. Alternatively, nail applicators can use preformed tips made of acrylics, gel, fiberglass, or porcelain. These preformed tips are adhered to the natural nail with cyanoacrylate glue. Acrylates, gels, fiberglass, or cloth wraps are then used to fill around the tip as in sculptured nail methods and the nails are filed. Gallagher et al have recently reported three cases of occupational asthma related to nail sculpture in England.²⁶

Hairdressers

Our study extends the case reports and epidemiologic literature regarding hairdressers and occupational asthma by quantitating the excess risks of asthma and asthma exacerbation among those who style hair compared with those cosmetology

professionals not performing this service (Table 3). Hairstyling consists of hair shampooing, rinsing, coloring, bleaching, setting, permanent waving, and hairspraying, many of which may involve exposure to respiratory sensitizers, as documented in case reports. In addition, we had the advantage of documenting the minimum magnitude of healthy worker effect in cross-sectional studies, because our cohort included still-licensed cosmetology professionals who had left employment in the industry often for respiratory health reasons.

Barbers

Shaving and honing was one of the three tasks performed by cosmetology professionals, which conferred excess risk of development of asthma and its exacerbation at work. Shaving exposures include talc, aftershaves, soaps, and aerosolized foam. Honing is the sharpening of blades with a metal or bony object. We are unaware of previous reports of these activities in relation to occupational asthma, although metals such as nickel and chromium in stainless steels are sensitizing agents for asthma. The risk factor of shaving and honing requires confirmation in other studies, specific inhalation challenge study in suspected clinical cases, and workplace investigation for pertinent exposures.

Cosmeticians

Massage and skin care were associated with exacerbation of asthma and use of asthma medications. The odors and solvents associated with creams, oils, and perfumes used in these services may be adequate explanation for symptomatic exacerbation in those with airways hyperreactivity.

Work-Attributed Asthma Prevalence

The proportion of adult-onset asthma attributable to occupational exposures is of considerable public health interest. One estimate of the proportion of work-attributable asthma is 21% of incident cases in a health

maintenance organization.²⁷ Recent estimates of the work-attributable proportion of adult-onset asthma range from 4% to 58% with a median of 15%.²⁸ The proportion of work-attributable asthma among persons with exposure to known asthma-causing agents should be higher than in the general population.

Our survey allows two ways to estimate prevalence of work-attributed asthma in this survey population, members of which have exposure to known asthmagens. First, we used the 1990 surveillance case definition of occupational asthma,²² which requires work-related symptoms and a physician diagnosis of asthma since beginning work with an exposure to an agent or process previously associated with asthma. Of the 67 respondents with posthire asthma, 39 (58%) reported exacerbation of asthma with work exposure, thus meeting the surveillance case definition. Using this surveillance case definition, the incidence of occupational asthma since employment in our sample is 2.1%. The proportion of asthma occurring after entering the cosmetology profession, which may be occupational, is 58%. This method is subject to error in that cases not classified as occupational asthma may report exacerbation with irritant and odor exposures and not all cases of occupational asthma are likely to report work-related exacerbation. Despite these limitations of the 1990 surveillance case definition of occupational asthma, our calculations suggest that the majority of asthma cases arising among cosmetology professionals are work-related and certainly work-exacerbated. A further asthma burden exists in those with preexisting asthma that experience work aggravation of symptom frequency or severity. In our survey, 6.7% of the respondents had preexisting physician-diagnosed asthma, of whom 25% report their asthma to be exacerbated by work.

The second way in which we looked at work-attributable risk was by comparing the highest and the

lowest rates of posthire asthma among cosmetology professional subgroups. Cosmetologists had the highest rate (5.1%), and cosmeticians had the lowest rate (1.6%), which we assumed to be the baseline rate of developing asthma in the population independent of occupation. The difference of 3.5%, therefore, might be attributable to occupational asthma in the cosmetology subgroup. Thus, the proportion of asthma arising in the course of employment, which may be attributable to occupation, is 56% in the cosmetologist subgroup. This method is more robust in that we avoid misclassification of cases of occupational asthma based on questionnaire data. The method is limited by the misclassification of task-related exposure and risk based on license type. Nevertheless, the proportion is consistent with logistic regression modeling in which cosmetologist-performed services conferred two- to threefold risks of posthire asthma compared with persons who would have uncommonly performed high-risk services such as application of artificial nails and hairstyling.

Our study also demonstrated that morbidity from asthma, respiratory illness, and allergy in the cosmetologist subgroup is substantial, accounting for approximately half of those who left the profession for health problems acquired or exacerbated by work.

Conclusions

Our quantification of service-associated risk of asthma among cosmetology professionals has implications for future study, for clinical practice, and for prevention of work-associated asthma. Longitudinal follow up of persons entering the cosmetology professions would allow accurate assessment of asthma risk without the limitations of healthy worker effect likely among a cross-sectional study of current licensees.

Clinicians diagnosing new asthma among cosmetology professionals should recognize that the majority of

cases may be occupational in etiology. The restriction of such cases from further exposure to the causative agent or process is the treatment of choice.²⁹ Careful exploration of cause among such cases is likely to contribute to understanding specific agents, which may explain task-related asthma risk factors. Specific inhalation challenge or careful review of material safety data sheets for exposures, with substitution when possible, should lead to case reports with substantial impact in light of our epidemiologic evidence.

Finally, prevention of occupational asthma in the setting of an industry characterized by small employers is challenging. We suggest education through licensing bodies, trade associations, and patients; product substitution in the case of methacrylate-containing products and hair aerosols; and attention to engineering controls in the case of artificial nail application to exhaust sensitizing and irritant exposures away from the breathing zone.³⁰ The recognition of cases of possible occupational asthma can be a sentinel for the need for prevention of occupational asthma among coworkers, which can be activated by notification of public health authorities.

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