Occupational contact dermatitis: Retrospective analysis of North American Contact Dermatitis Group Data, 2001 to 2016

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Background: Patch testing is an important diagnostic tool for suspected allergic contact dermatitis (ACD) in occupational settings.

Objective: Provide an overview of occupational skin disease (OSD) and an analysis of occupational ACD in North American patients undergoing patch testing between 2001and 2016.

Methods: Patients with OSD were analyzed for frequency of allergic reactions to a screening series of allergens, occupational relevance, location of skin disease, and exposure sources. Demographic, occupation, and industry information were recorded.

Results: Of 38,614 patients evaluated, 4471 (11.6%) had OSD, of whom 3150 (70.5%) had ACD. The most common occupationally related allergens included rubber accelerators, preservatives, and bisphenol A epoxy resin. Hands (75.8%), arms (30.0%), and face (15.9%) were common sites of dermatitis. The occupations most affected were service workers and machine operators.

Limitations: Our cohort may not reflect the general working population.

Conclusion: This study identified common occupational allergens, exposure sources, and occupations/industries at risk. This information may help the clinician evaluate and manage patients with occupational contact dermatitis. (J Am Acad Dermatol 2022;86:782-90.)

Key words: allergic contact dermatitis; contact allergy; occupational; occupational allergic contact dermatitis; occupational irritant contact dermatitis; occupational skin disease; patch tests; surveillance.

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Funding sources: None.

IRB approval status: Institutional Review Board approval for data collection was obtained by each member, specific to their organization, and the study was reviewed and approved by Unity Health Toronto Research Ethics Board.

Accepted for publication March 6, 2021.

Reprints not available from the authors.

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Published online March 19, 2021.

0190-9622/$36.00

https://doi.org/10.1016/j.jaad.2021.03.042

INTRODUCTION

Occupational skin disease (OSD) accounts for almost 30% of all occupational illnesses.[1] It is the second most common occupational illness in the United States, after musculoskeletal injuries.[2] Occupational contact dermatitis (OCD) comprises 90% of all OSDs and includes allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD).[3] OCD can negatively impact function and quality of life, disrupt work, and have economic consequences.[4] Information about OCD can come from a variety of sources, including government agencies, workers compensation and insurance agencies, OSD registries, patch test databases, workplace studies, and case reports.[4] Recent retrospective studies have analyzed sizable populations, including examinations of the Finnish Register of Occupational Diseases (2005-2016) and the North Eastern Italian patch test database (1996-2016).[5,6] The European Surveillance System on Contact Allergy (ESSCA) network examined their 2002-2010 data. An occupational analysis of a large North American patch test population has not been conducted within the past 20 years.[7,8]

The North American Contact Dermatitis Group (NACDG) is a group of dermatologists based in Canada and the United States who use patch testing to evaluate patients with suspected contact dermatitis. The NACDG uses a screening series that is re-evaluated and adjusted every 2 years.[9-16] The purpose of this retrospective study is to describe the characteristics and patch test results of workers diagnosed with OSD who were included in the NACDG database between 2001 and 2016. Areas of inquiry included the frequency of occupational ACD, demographics of affected individuals, major occupations/industries represented, and causative allergens and their sources.

CAPSULE SUMMARY

- This article provides an update on occupational contact dermatitis in North America between 2001 and 2016, including relevant allergens, exposure sources, and associated occupations/industries.
- Knowledge of common allergens, their exposure sources, and the occupations/industries at risk can help guide diagnostic evaluation and facilitate prevention on an individual level and in the workplace.

METHODS

The NACDG began recording consecutive 2 year period of patch test cycle data in 1992.[9-19] Since 2001, detailed codes recording the exposure source have been included. Between 2001 and 2016, the NACDG completed 8 patch test cycles with a screening series of allergens. Institutional Review Board approval for data collection is obtained by each member, specific to their organization. Patch testing was performed in accordance with NACDG standards.[15,19]

A final determination of "allergic/positive" or "not allergic" was determined by each investigator, based on the temporal pattern, patch test appearance, and known characteristics of that allergen. The clinical relevance of positive patch test reactions was determined using the patient's history and by examining the skin. Relevance was coded as current ("definite," "probable," or "possible"), past, or unknown.[19] Patients were tested to supplemental allergens as determined by each individual physician, depending on the patient's clinical presentation and occupation. Up to 3 sites of dermatitis and 3 diagnoses could be coded for each patient. The physician interpreted whether positive reactions were related to the patient's occupation. A primary exposure source for each occupationally relevant screening allergen was identified. An exposure source was also classified for patients who were positive to supplemental allergens; the names of these allergens were not specifically recorded.

Occupation and industry were coded for each patient by an occupational expert using the United States 1990 Census Bureau codes, based on answers to a series of 5 standardized questions.[20,21] All data were manually entered into a database at a centralized location using Access software (Access 2010; Microsoft Corporation, Redmond, WA). Comparative statistical analyses were performed using R version 4.0.2 (2020; R Core Team, Vienna, Austria). Demographics, occupational relevance, exposure sources, and affected occupations/industries were presented using descriptive analyses, including frequencies, counts, and proportions. For each of the top allergens, logistic regression was used to analyze the annual trend in the proportion of patients with an occupationally relevant patch test. Year was modeled as a linear covariate and the odds ratio (OR) for a 1-year increase was reported. P values $< .05$ were considered statistically significant. There were no statistical adjustments for multiple comparisons.

RESULTS

Patient characteristics

Of 38,614 patients tested, 4471 (11.6%) had OSD. Demographics and disease characteristics of these

Abbreviations used:

ACD:	allergic contact dermatitis
CI:	confidence interval
ESSCA:	European Surveillance System on Contact Allergy
ICD:	irritant contact dermatitis
MCI/MI:	methylchloroisothiazolinone/methylisothiazolinone
NACDG:	North American Contact Dermatitis Group
OR:	odds ratio
OSD:	occupational skin disease

OSD patients were described using MOAHLFAP (male, occupational, atopic, hand, leg, face, age older than 40 years, proportion of positivity) guidelines (Supplemental Table S1; available via Mendeley at https://data.mendeley.com/datasets/yvgg24th6g/1).[22]

More patients were male (51.4%) and most patients were Caucasian (87.1%) and older than 40 years of age (55.3%; median age, 43 years). Atopic characteristics included hay fever (26.8%), eczema (19.3%), and asthma (14.5%). The most common sites of dermatitis were hands (75.8%), arms (30.0%), face (15.9%), and scattered generalized areas (12.4%; Table S2). Most patients were diagnosed with occupational ACD (70.5%) and/or ICD (45.7%). Ten percent had atopic dermatitis, and all other diagnoses occurred in fewer than 5% (Table S3).

Allergens

Within the cohort of individuals with occupational ACD, 81.7% had positive reactions only to NACDG screening series allergens, 13.1% also reacted to 1 or more supplemental allergen(s), and 5.2% had positive reactions only to 1 or more supplemental allergen(s).

Table I shows the allergens with the greatest proportions and frequency of occupationally related reactions. The 10 most common occupational patch test substances were carba mix (9.7%), thiuram mix (9.6%), methylisothiazolinone (MI; 9.3%) bisphenol A epoxy resin (5.6%), diphenylguanidine (5.4%), formaldehyde 1% aq (3.9%), nickel sulfate hexahydrate (3.8%), potassium dichromate (3.6%), 2-hydroxyethyl methacrylate (3.4%), and cobalt chloride hexahydrate (3.2%). Bisphenol A epoxy resin had the highest percentage of occupationally relevant reactions (83.9%), followed by thiuram mix (80.0%), carba mix (79.1%), Bisphenol F epoxy resin (75.7%), and 2-hydroxyethyl methacrylate (73.5%; Table I).

Allergen trends

Over the 16-year study period, statistically significant increases were found in the ORs of patients having an occupationally relevant reaction to carba mix (OR, 1.034; confidence interval [CI], 1.014-1.054; $P < .001$), and methylchloroisothiazolinone/methylisothiazolinone [MCI/MI] (OR, 1.193; CI, 1.147-1.244; $P < .001$; Fig 1). Table S4 demonstrates the significant downward trend of 2-mercaptobenzothiazole (Table S4).

Occupations and industries

Major occupational groups included service workers (20.3%), machine operators/assemblers/inspectors (17.0%), precision production workers (11.0%), mechanics/repairers (8.3%), and health professionals (7.4%; Table II). The most common industries were hospitals (13.5%), transportation equipment (9.2%), personal services (8.6%), construction (5.4%), and health practitioners offices (5.0%; Table II). The most commonly affected occupations/industries associated with the most frequently identified occupational allergens are provided in Table III.

Sources of occupationally related allergens

Gloves were the most common source of occupational ACD among screening allergens, followed by hair dyes, cement/concrete/mortar, adhesives/glues/bonding agents, and coatings. The most common sources for each of the top 10 patch test substances, and the proportion of OCD attributed to each source, are shown in Table IV. For patients tested to supplemental allergens, top sources were adhesives/glues/bonding agents, hair dyes, gloves, coatings, moisturizers/lotions/creams, and metalworking fluids.

DISCUSSION

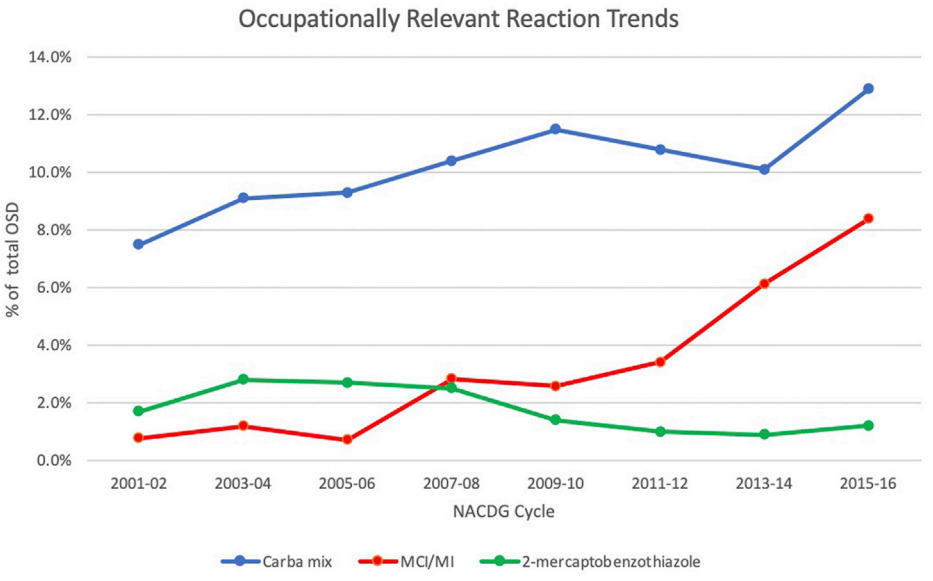
In this analysis of 38,614 patch-tested patients, 11.6% had OSD and 8.2% had allergic OCD. These numbers represent proportions of OSD and ACD among NACDG patch-tested patients and not the North American population in general. Several groups have examined patch test results over at least an 8-year interval. The ESSCA analyzed data from patients diagnosed with OCD across 11 countries between 2002 and 2010 and reported a higher prevalence of OCD (24.0%).[7] In contrast, analysis of 18,859 Italian patients between 1996 and 2016 identified 10.4% with OCD.[6] The German Contact Dermatitis Group diagnosed 16.2% of patch-tested patients between 2010 and 2012 with occupationally related disease.[23] The NACDG examined its results between 1998 and 2000 and found 19% to be occupationally related.[8]

One of the challenges in making comparisons is the variation in the outcome of interest. Some report all OSD and others report OCD or specifically occupational ACD. Others restrict the age range,

Table I. The most common occupational allergens

Allergens/allergen mixes	Number of patients with OSD tested	Total positive reactions	Occupationally relevant positive reactions				
			Number of patients	Occupational positives/ patients tested (%)	Rank order	Occupational positives/ total positives (%)	Rank order
Carba mix (3% pet)	4454	549	434	9.7%	1	79.1%	3
Thiuram mix (1% pet)	4460	536	429	9.6%	2	80.0%	2
Methylisothiazolinone (0.2% aq)*	1025	200	95	9.3%	3	47.5%	22
Bisphenol A Epoxy resin (1% pet)	4471	298	250	5.6%	4	83.9%	1
Diphenylguanidine (1% pet)*	1025	80	55	5.4%	5	68.8%	11
Formaldehyde (2% aq)†	1023	116	40	3.9%	6	34.5%	34
Formaldehyde (1% aq)	4470	433	174	3.9%	7	40.2%	24
Nickel sulfate hexahydrate (2.5% pet)	4438	809	170	3.8%	8	21.0%	44
Potassium dichromate (0.25% pet)	4458	260	161	3.6%	9	61.9%	13
2-hydroxyethyl methacrylate (2% pet)*	2461	113	83	3.4%	10	73.5%	5
Cobalt (ii) chloride hexahydrate (1% pet)	4442	449	144	3.2%	11	32.1%	36
4-phenylenediamine (1% pet)	4452	280	140	3.1%	12	50.0%	20
Methylchloroisothiazolinone/ methylisothiazolinone (0.1% aq)	4455	281	133	3.0%	13	47.3%	23
Glutaraldehyde (1% pet)‡	3899	131	92	2.4%	14	70.2%	9
Quaternium-15 (2% pet)	4455	427	105	2.4%	15	24.6%	40
Glyceryl thioglycolate (1% pet)§	3026	92	64	2.1%	16	69.6%	10
2-mercaptobenzothiazole (1% pet)	4466	110	78	1.7%	17	70.9%	8
Fragrance mix I (8% pet)	4431	376	70	1.6%	18	18.6%	46
Ammonium persulfate (2.5% pet)	572	25	9	1.6%	19	36.0%	33
Bipshenol F epoxy resin (1% pet)‖	1826	37	28	1.5%	20	75.7%	4

OSD, Occupational skin disease; *pet*, petrolatum.
*Included only in 2013 to 2016 screening series.
†Included only in 2015 and 2016 screening series.
‡Removed after 2014.
§Removed after 2010.
‖Removed after 2008.



†*Statistically significant changes by year in the percentage of OSD patients with occupationally relevant reactions to selected patch test substances*

Fig 1. Relevant reaction trends in occupational allergic contact dermatitis, 2001-2016.†

Table II. Occupations and industries of patients with occupational skin disease

Occupation (N = 4140)	n (%)
Service occupations*	840 (20.3%)
Machine operators/assemblers/inspectors	702 (17.0%)
Other precision production occupations†	455 (11.0%)
Mechanics/repairers	344 (8.3%)
Health assessment/treating occupations	306 (7.4%)
Construction trades	194 (4.7%)
Handlers/equipment cleaners/ helpers/laborers	185 (4.5%)
Health technologists/technicians	169 (4.1%)
Health diagnosing occupations	130 (3.1%)
Executive/administrative/managerial occupations	105 (2.5%)

Industry (N = 4143)	n (%)
Hospitals	559 (13.5%)
Transportation equipment	382 (9.2%)
Personal services‡	356 (8.6%)
Construction	224 (5.4%)
Offices of health practitioners	205 (5.0%)
Metal industries	165 (4.0%)
Health services, NEC	160 (3.9%)
Repair services	151 (3.6%)
Chemicals and allied products	149 (3.6%)
Eating and drinking places	138 (3.3%)

N, Number; *NEC*, not elsewhere classified.
*Includes professions such as cleaners/janitorial, hairdressers, cooks, waiters. Excludes protective/household professions, such as police, firefighters, private household cleaners, housekeepers, and childcare workers.
†Includes professions such as sheet metal workers, metal engravers, electronic equipment assemblers, and cabinet makers.
‡Excludes private households/lodging.

exclude the unemployed, or vary in the inclusion of clinics specializing in OCD. It is frequently reported that ICD is a more common occupational skin disease than ACD.[3,24] Here, the proportion of ACD among patients with OCD was 70.5% versus 45.7% for ICD. This may be due to selection bias; patients suspected to have ACD would be more frequently referred for patch testing than those with suspected ICD.

Industries

Hospitals had the greatest number of cases of OSD. ACD and ICD are common diagnoses within the healthcare sector.[25-27] Sources of occupational ACD include nickel, components of disinfectants, and rubber accelerators in latex/nitrile gloves.[25,26]

Occupations

The most commonly affected occupations in our study were service occupations, including personal service workers (hairdressers/cosmetologists), cleaning/building service occupations (janitors/cleaners), and food service workers (cooks/kitchen workers/waiters). The ESSCA found the greatest risk of OCD to be in personal service workers (hairdressers, healthcare professionals, and metal workers).[7] The Italian data identified hairdressers/barbers/beauticians as the most affected, followed by cooks, metal workers, chemical industry workers, and construction workers.[6] The Finnish Register on Occupational ACD highlighted farmers, hairdressers, healthcare workers, cooks, cleaners, and metal workers.[5] The 1998-2000 NACDG analysis found high rates of OCD in assemblers/machinists, hairdressers, and nurses.[8] These results are largely consistent with our data, which are derived from patch-tested workers with OCD, not the general population as a whole.

ACD in hairdressers/cosmetologists is well documented; common allergens include p-phenylenediamine, glyceryl thioglycolate, 2-hydroxyethyl methacrylate, quaternium-15, nickel, and thiurams, which are found in hair dyes, other cosmetic products, instruments, and personal protective equipment.[28,29] Cleaners and janitors often work with disinfectants and rubber containing allergens, such as formaldehyde, MI, and thiurams, contributing to the high prevalence of OCD in this workforce.[30] ICD among restaurant workers is commonly reported, due to contact with water, oils, detergents, and foods.[31]

Machine operators/assemblers/inspectors were the second most common group affected. Machinists are at elevated risk due to exposure to metalworking fluids.[32-34] Contact allergy to MCI/MI, other biocides, and corrosion inhibitors is often diagnosed in machinists.[35] A Swedish study diagnosed 22 of 163 (13.5%) metalworkers with OCD to neat oils, cutting fluids, or biocides, with ACD in 10 and ICD in 12.[36] A large-scale study from Germany found formaldehyde and formaldehyde releasers to be common occupational allergens among metal workers.[37]

Allergens and their sources

The most common occupational allergens/mixes identified in this study were carba mix (CM), which includes the rubber accelerators zinc dibutyldithiocarbamate, zinc diethyldithiocarbamate, and the chemically unrelated diphenylguanidine (DPG), thiuram mix (TM), MI, bisphenol A epoxy resin, formaldehyde, and nickel. The 1998-2000 NACDG study produced similar findings.[8] The ESSCA also reported the most prevalent occupational allergens included thiurams, epoxy resin, and formaldehyde, in addition to MCI/MI and methyldibromoglutaronitrile.[7]

CM showed the sharpest increase in prevalence across our study period (OR, 1.034; CI, 1.014-1.054;

Table III. Top sources for the top occupational allergens tested across the entire study period 2001-2016

Allergen/allergen mixes	Source	Occupationally relevant reactions to the allergen (%)
Carba mix (3% pet)	Gloves	85.5%
	Safety equipment, miscellaneous (e.g., masks, respirators)	2.7%
	Vehicles (air, rail, road, water)	2.3%
Thiuram mix (1% pet)	Gloves	88.1%
	Safety equipment, miscellaneous (e.g., masks, respirators)	3.0%
	Vehicles (air, rail, road, water)	1.4%
Bisphenol A epoxy resin (1% pet)	Adhesives, glues, bonding agents	24.8%
	Coatings (paint, lacquer, shellac, varnish, stains)	16.4%
	Epoxy resins (raw material)	8.4%
Formaldehyde (1% aq)	Metalworking fluid, cutting oils	3.4%
	Liquid, lotion and bar soaps, cleaners	2.9%
Nickel sulfate hexahydrate (2.5% pet)	Tools	15.9%
	Equipment, instruments, miscellaneous supplies	11.8%
	Jewelry	10.6%
Potassium dichromate (0.25% pet)	Cement, concrete, mortar	35.4%
	Gloves	15.5%
	Coatings (paint, lacquer, shellac, varnish, stains)	6.2%
Cobalt (ii) chloride hexahydrate (1% pet)	Cement, concrete, mortar	13.9%
	Metallic elements, dusts, powders, fumes	11.8%
	Tools	8.3%
4-phenylenediamine (1% pet)	Hair dyes	82.3%
	Shoes, boots, sandals, slippers	2.9%
Methylchloroisothiazolinone/ methylisothiazolinone (100 ppm aq)	Liquid, lotion and bar soaps, cleaners	19.5%
	Waterless hand soaps	18.8%
	Shampoos, conditioners	14.3%
Quaternium-15 (2% pet)	Moisturizers, lotions, creams	17.1%
	Cosmetics, beauty preparations, skin and healthcare products	12.4%
	Liquid, lotion and bar soaps, cleaners	11.4%

aq, Aqueous; *pet*, petrolatum; *ppm*, parts per million.

$P < .001$), a trend confirmed by other groups. A study from the United Kingdom conducted on rubber contact allergy between 1996 and 2012 showed a significant rise in the frequency of occupational cases attributable to CM, with a 10.1% average increase annually.[38] The same trend was reported in a multicentre European study, where occupational ACD to CM was found in 5.5% of 1854 patients tested.[39]

The proportions of accelerators used in synthetic rubber gloves have changed to decrease exposure to natural rubber latex in gloves. Dithiocarbamates are now the main accelerators, accounting for their increasing contribution to occupational ACD in such groups as health care workers and food processors.[40-43] In our study, gloves were by far the most common source of occupational ACD.

There are a few caveats to the inclusion of CM as a screening patch test preparation. A study from Sweden of patients with known ACD to rubber accelerators found that patch test positivity to individual dithiocarbamates was closely associated with positivity to the equivalent thiuram compound.[44] A Finnish investigation reported that in 34 dithiocarbamate positive patients, there were no independent reactions to thiurams, obviating the need for screening with carba mix.[45] Separate NACDG analyses have discussed the limitations of CM, including its potential for causing irritant (false-positive) patch test reactions.[46,47] However, in 947 patients with strong positive reactions (2+, 3+) to CM and/or TM, 31.4% (297 of 947) with strong reactions to CM would have been missed by testing TM alone.[46] Similar results have been reported from Denmark.[48] Supplemental testing to individual rubber accelerators may be required in some cases.

In our study, MI was one of the most common allergens, although it has only been on the screening series since 2013. This is reflected in the significant increase in occupational ACD to MCI/MI between 2001 and 2016 (OR, 1.034; CI, 1.014-1.054; $P < .001$). The results of other pooled databases have shown similar trends. Personal care products are the

Table IV. Top Industries and occupations and most common allergens

Allergen	Top industries	Number of cases	Top occupations	Number of cases
Carba mix (3% pet)	Hospitals	159	Service occupations, except protective and household	109
	Offices of health practitioners	66	Machine operators, assemblers, and inspectors	106
Thiuram mix (1% pet)	Hospitals	164	Service occupations, except protective and household	141
	Offices of health practitioners	73	Machine operators, assemblers, and inspectors	95
Bisphenol A epoxy resin (1% pet)	Transportation equipment	67	Machine operators, assemblers, and inspectors	113
	Electrical machinery, equipment, and supplies	58	Precision production occupations	93
Formaldehyde (1% aq)	Hospitals	72	Service occupations, except protective and household	123
	Personal services, except private households	53	Machine operators, assemblers, and inspectors	99
Nickel sulfate hexahydrate (2.5% pet)	Hospitals	159	Service occupations, except protective and household	276
	Personal services, except private households	118	Machine operators, assemblers, and inspectors	169

pet, Petrolatum.

primary source of MI, but substantial occupational risk exists for hair/beauty industry workers, cleaners, health care workers, and machinists, due to its presence in shampoos, cleaning products, and workplace hand cleansers/lotions.[49-51] In our study, 52.5% of positive reactions to MI were considered occupationally relevant. Liquid lotions/bar soaps/cleansers, waterless hand soaps and shampoos/conditioners were the top 3 sources of exposure. Occupational ACD to MI increased significantly in the United Kingdom between 2008 and 2012, as its use in industrial and personal care products increased; health care workers, painters, hairdressers, and manufacturing professions were highlighted.[49] The Finnish Institute of Occupational Health found 36 of 1745 patients with positive reactions to MCI/MI and/or MI attributed to occupational exposure, especially liquid soaps and industrial hand cleansers.[52] An Australian case series reported similar sources, as well as paints and industrial biocides.[53]

Our data showed bisphenol A epoxy resin was another important occupational allergen, affecting 5.6% (250 of 4471) of OSD patients. It ranked number 1 for test positives attributed to an occupational source, 83.9% (250 of 298), which is consistent with the 1998-2000 NACDG analysis.[8] This is not surprising, given that epoxy resins are one of the major causes of occupational ACD.[54] Common sources in the current study include adhesives/glues/bonding agents and coatings, like paint and lacquer. Similarly, the ESSCA reported epoxy resin allergy in 3.1% of 9969 tested patients with OCD; most common exposures occurred in workers who used epoxy glues and paints.[7] Reports of contact allergy to epoxy resins may underestimate its full extent, as a screening series of allergens is not enough to detect some cases of occupational ACD to epoxy. Comprehensive evaluation requires testing to supplemental allergens and worksite epoxy-related compounds, appropriately diluted.[55]

Nickel is the most frequent cause of contact allergy worldwide and consumer sources, including jewelry and metal in clothing, are more commonly reported.[56] In our population, 3.8% had occupationally related reactions to nickel. Only 21% of the positive reactions were deemed occupationally relevant. Common sources included tools, equipment, and instruments. Using data collected between 1998 and 2016, the NACDG described occupationally relevant patch test reactions to nickel, with primary sources being instruments/equipment, vehicles/machinery, tools, and jewelry. Occupations at greatest risk were hairdressers/cosmetologists, machine operators, and healthcare workers.[57] Other reported sources included tools, keys, electrical components, coins, sewing needles, dental tools/alloys, and crochet hooks.[58]

Our study, spanning a 16-year period, is the largest reported analysis of OSD from North America. Among patients with occupationally relevant patch test reactions, 18.3% had a positive test to a nonscreening allergen and only 5.2% had 1 or more

positive patch test(s) to supplemental allergen(s) and/or workplace materials. If only the screening series had been used, the source would have remained unknown, with implications for diagnosis, management, and prognosis.

Limitations

Our cohort represents a referral population. Not all patients who may have contact dermatitis are tested, so the data may not reflect the actual percentage of OCD in the general population. There can be significant barriers to testing, such as lack of health insurance, inability to take time off of work, and concerns for job loss if an allergy is confirmed. The NACDG does not collect data on supplemental allergens other than presence and source.

CONCLUSIONS

OSD was found in 11.6% of patients patch tested by the NACDG between 2001 and 2016. Most (70.5%) had occupational ACD. Twenty percent of patients with occupationally relevant ACD would have been inadequately assessed if only tested with the screening series. Important occupational allergens included rubber accelerators, bisphenol A epoxy resin, MI, formaldehyde, and nickel. Knowledge of common occupational allergens, sources of exposure, and occupations/industries at risk is important to facilitate prevention and treatment.

The authors thank Rick Wang for his statistical contributions to the manuscript.

Conflicts of interest

Dr Warshaw has received an investigator-initiated grant from Wen by Chaz Dean and served as a consultant for Wen by Chaz Dean and Noven Pharmaceuticals. Dr Atwater received a Pfizer Independent Grant for Learning & Change and has consulted for Henkel. Dr Sasseville receives royalties from UpToDate (Wolters Kluwer Health). Dr Taylor owns non-controlling shares of stock in AstraZeneca, Cigna, Merck, Johnson & Johnson, and Opko Health and he has consulted for Kao Brands and Monsanto (Bayer), is a member of the Cosmetic Ingredient Review Steering Committee, and has a nondependent child employed by Pfizer. Drs J DeKoven, Mathias, Belsito, Fowler, Pratt, Zug, Maibach, DeLeo, Silverberg, Reeder, and Holness, and Author B DeKoven have no conflicts of interest to declare.

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