

Occupational dermatologic conditions in nail salon technicians

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To the Editor

The nail salon industry in the United States has grown exponentially over the past few decades, employing approximately 395,658 workers as of 2018, with a projected growth rate of 9% by 2032.^{1,2} Owing to minimal entry requirements into the workforce, the industry has seen a rise in the proportion of immigrant workers.³ Notably, the proportion of Vietnamese nail technicians has surged from 10% in 1987 to 59% in 2002, after adjusting for the industry's overall growth.⁴

Despite this growing multi-billion-dollar industry, occupational health and safety protocols are not federally standardized, leaving state agencies responsible for establishing these requirements.^{1,3} Consequently, community-based initiatives, such as the Healthy Nail Salon Collaborative in California and the Healthy Nail Salons Coalition in New York, have pioneered protective policies for the health of nail technicians.^{3,5-7} However, in states where leadership in advocacy coalitions is lacking and training regulations are poorly adopted, nail technicians face significant occupational hazards.^{3,5,8}

Few studies have focused specifically on the dermatologic manifestations of routine chemical exposure while working in this industry. As such, this literature review aims to support ongoing community-based efforts to improve worker safety in immigrant-dominated industries, including nail salons, by synthesizing the medical literature on occupation-associated dermatologic symptoms. Enhancing the understanding of potential health hazards can help strengthen safety regulations and promote better compliance.

A scoping literature review was performed utilizing Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines and the following search terms: (*occupational* or *workplace* or *work*) and (*skin disease* or *skin condition* or *dermatology* or *skin* or *skin cancer*) and [*nail* and (*spa* or *salon*)] or (*manicurist* or *pedicurist*). PubMed, Embase, CENTRAL, and MEDLINE databases were used to identify primary literature focusing on nail salon workers with acquired occupational

dermatologic conditions. The reference lists of pertinent studies were also reviewed to identify additional relevant publications. The literature review was performed through April 26, 2024, for all databases.

Case reports, case series, and cross-sectional studies were included. Other study types such as randomized controlled trials, systematic reviews, and meta-analyses were not included due to either lack of availability or pertinence to this review's focus. Eligible studies had to be available in English. Studies that did not address nail salon workers and quantify the number of occupation-associated dermatologic conditions were excluded.

Three authors, VXP, NFB and HHP, separately conducted an assessment to determine the eligibility of articles for inclusion. Subsequently, the remaining author (SIBJ) collectively evaluated the suitability of the articles, with the aim of achieving unanimous consensus. Included studies ranged from the years 2005 to 2023. Critical appraisal of the included articles was done using the Oxford Centre for Evidence-Based Medicine (CEBM) levels of evidence scoring. Other collected data included method of data collection, number of surveyed/assessed nail salon workers, number of those presenting with occupation-related dermatologic conditions, associated chemicals, anatomical distribution, and glove use. Variations in glove use, such as glove material and layering, were not stratified in our analysis. Instead, we only considered whether or not gloves were used. Chemicals were considered to be linked to a dermatological presentation if supported by patient history, positive patch testing, or reported by the authors.

Analysis was done using Microsoft Excel to characterize the included participants. Analyzed characteristics included the type of skin irritation reported, anatomic distribution of reported symptoms, chemicals identified as allergens, and the use of protective equipment.

A total of 55 articles were identified when queried. After cross-referencing and excluding 6 duplicates, 49 articles were then screened by their titles and abstracts by relevance and inclusion criteria. From this initial screen, 19 full-text articles were identified, and reference screening resulted in the inclusion of four additional articles. Of

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these 23 studies, four were excluded, resulting in a total of 19 articles included in our review. [Table 1](#) summarizes the articles that met the inclusion criteria.⁹⁻²⁷

Among the 2,034 nail salon workers identified in the analysis, 253 (12.4%) reported skin symptoms related to their work. Of those reporting skin irritation, 117 (46.2%) were diagnosed with allergic contact dermatitis (ACD), with some undergoing patch-testing. The remaining 136 (53.8%) cases had undiagnosed "skin irritation" or irritant dermatitis related to exposure to chemicals in nail products, and one individual had a fungal infection involving the thumb. In general, most studies did not specifically describe the dermatologic lesions, using vague terms such as "skin rash," "burning," and "itching." Involvement of the hands was most common, as seen in 67.5% (n=79) of the documented ACD cases. More specifically, 26.5% (n=31) involved the fingertips^{9,20,27} and 25.6% (n=30) involved the palms ([Table 2](#)).^{9,16,18}

A significant number of workers (25.6%, n=30) also reported facial involvement.^{12,14-16} Rarely, other areas were also affected, including the forearm, neck, and eyelids, making up approximately 5% or less of the total documented ACD cases.

Of the 19 included studies, 6 utilized patch testing to identify causative agents and two studies employed air quality monitors to measure levels of volatile organic compounds. Various allergens were reported, with predominantly acrylates in 12 studies, 2-hydroxyethyl methacrylate (2-HEMA) in 8 studies,^{9,16-18,20,25-27} and ethylene glycol dimethacrylate (EGDMA) in 6 studies ([Table 3](#)).^{9,16,17,20,25,27} Additionally, among the 9 studies that surveyed nail salon technicians regarding glove use, an average of 76% reported using gloves.^{12-14,17,19,21-25} However, in the two studies that examined glove use with acrylic nail products and fine nail art detailing, gloves were used an average 25.5% of the time.^{13,17}

With only 42% of nail technicians in California with employer-provided health insurance, many are never formally evaluated by a dermatologist and continue to be exposed to occupational hazards without appropriate treatment.^{12,28} Furthermore, owing to demanding work hours, nail salon workers often encounter challenges with scheduling a dermatology evaluation.²⁹ Unfortunately, about 30% of nail technicians are prohibited from taking time off for health appointments and for those who can, such absences are often unpaid.^{28,30} Owing to barriers to care and occupation-associated dermatologic conditions, such as ACD, many are unable to continue working.⁹ Our study highlights occupation-associated skin issues among nail salon workers and low rates of personal protective equipment (PPE) use, emphasizing the need to improve safety practices and reduce barriers to health care.

Despite these adverse health outcomes, many nail salon owners cite several barriers to implementing safe practice, including the high cost of safety measures, insufficient time for training, and limited availability of PPE at local suppliers.^{31,32} Unfortunately, nail technicians are often reluctant to report safety violations because of a

mistrust of government oversight and fear of retaliation, potentially affecting their income and job security.²⁸ This hesitancy contributes to the overall inadequate oversight of safety practices in nail salons. For example, a New York Times investigation revealed that the New York State Department of Labor did not routinely investigate nail salons and instead only responded to formal complaints submitted by nail salon workers.^{33,34}

Beyond the nail salon industry, various studies have also evaluated for occupation-associated dermatologic conditions in other beauty sectors, including among hairdressers and barbers, which demonstrated similar issues.^{35,36} For example, Symanzik et al conducted a similar literature review of irritants in hairdressing products, such as perm solutions and hair dyes; they found high rates of occupational ACD.³⁵ Owing to these risks, some countries have implemented standardized training to reduce irritant exposure in hairdressing vocational schools. Havmose et al describes one such program in Denmark, focusing on educating hairdressing apprentices about ACD and proper glove use and sizing when handling irritating chemicals.³⁷ These training programs can serve as examples in the United States to address the insufficient safety practices in nail salons.

Some may argue that the responsibility of such occupational hazards falls on the manufacturers who use irritants such as acrylates in their products. Steunebrink et al found that more than 30% of nail cosmetic products failed to meet European Union mandatory health warnings, despite the majority containing methacrylates.³⁸ Products including nail polish and sculpting gel are common nail products containing acrylates.³⁹ EGDMA and 2-HEMA, other common allergens reported in the literature, are found in artificial nails and nail adhesives. Advocacy groups such as the Campaign for Safe Cosmetics, have prioritized the discontinuation of harmful chemicals.⁴⁰

However, given the substantial industry-level changes required to adopt safety practices, such as promoting acrylate-free products, addressing employee-level prevention and access to educational materials may be more feasible and lead to immediate impact. Nguyen et al suggests that implementing safety measures requires greater collaboration between government and non-government stakeholders in the industry.³² This approach involves incentivizing partnerships in the community to raise awareness and provide representation for immigrant and refugee workers who may be less comfortable advocating for themselves.⁴¹

This study highlights the available data on occupation-associated skin findings in the nail salon industry and the suboptimal use of protective coverings when working with chemicals, such as acrylates. Limitations of this study include bias derived from self-reported data and the simplification of glove use data. Furthermore, the various dermatologic symptoms reported were nonspecific, such as *skin irritation* and *itch*, and do not accurately represent the specific skin conditions. Future investigations are needed to clearly define the dermatologic con-

Table 1. Summary of Included Studies

Reference: study location	Study design (Level of evidence)	Exposure assessment	# Exposed, # Cases	Inciting Chemical Exposure ^a	Dermatitis Distribution	Glove Use
Kolar et al. (2022): Croatia	Case Report (IV)	Clinical exam	n = 1 exposed n = 1 case of ACD	2-HEMA, EGDMA, EMA, HEA	Bilateral palmar distribution of the hands (especially hyponychium of fingertips)	N/A
Tran et al. (2020): Vietnam	Cross-Sectional (II)	Interview	n = 100 exposed n = 17 cases of skin irritation	Acetates, acrylates, toluene, methyl ethyl ketone, xylene (via ventilation assessment)	N/A	N/A
Park et al. (2014): Korea	Cross-Sectional (II)	Interview	n = 159 exposed n = 51 cases of skin irritation (n=17 eczema, n=29 pruritus/itching)	Butyl acetate, ethanol, ethyl acetate, isopropyl alcohol (via ventilation assessment)	N/A	N/A
Roelofs et al. (2008): Boston, USA	Cross-Sectional (II)	Interview	n=71 exposed n=22 indicated "Yes" in response to: "In the past 6 months, have you had redness, itching, rashes, burning, dryness, or scaliness on any part of your skin"	Artificial nail liquid/paste	Face/cheeks (n=11) Hands (n=9)	Prevalence of skin symptoms significantly lower for those who used gloves versus those who never used gloves (Prevalence ratio = 0.5, CI: 0.26-0.98)
White et al. (2015): Oregon, USA	Cross-Sectional (II)	Survey	n=65 exposed n=7 cases of skin irritation	N/A	N/A	92% always, 3% sometimes, 5% rarely/never wore gloves during manicures and pedicures 20% always, 8% sometimes, 72% never wore gloves during acrylic nail applications
Havmose et al. (2022): Denmark	Cross-Sectional (II)	Survey	n = 1218 exposed n = 54 cases of ACD	Acrylate	Hands only (n=45) Hands and Face (n=7) Face only (n=2)	Glove use in 23%

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Ramos et al. (2014): Portugal	Retrospective Case Series (IV)	Chart review	n=22 exposed n=20 cases with positive reactions for extended series of (meth)acrylates	2-HPMA (n=29/122 positive tests), 2-HEA (n=20/122 positive tests), and TriEGDA (n=16/122 positive tests)	Hands (n=19) Face (n=4) Forearms (n=2) Eyelids (n=2)	N/A
Gospodinova et al. (2023): Bulgaria	Retrospective Case Series (IV)	Chart review	n=34 positive cases of nail technicians with ACD	Cobalt, 2-HEMA, 2-HPMA, Nickel, EGDMA, 2-HEA	Palms (n=27) Fingers (n= 21) Face (n=6) Neck (n=6)	N/A
Morgado et al. (2019): Portugal	Case Series (IV)	Patch Testing	n=3 cases of nail aestheticians with eczema	Case 1: Positive to nail gel Case 2: HEMA, HPMA, hydroxyethyl acrylate, EGDMA, and TREGDA Case 3: HEMA, HPMA, EGDMA, TREGDA, ethyl acrylate, and tetrahydrofurfuryl	Case 1: Hand Case 2: Eyelid and hand Case 3: Pulpitis of hand	Case 1: Prolonged exposure (24 hours) to gel polish over all types of gloves caused positive reaction Case 2: Exposure to nail gel and HEMA over nitrile and latex gloves showed negative readings Case 3: Used nitrile gloves in practice, positive result over nitrile gloves when HEMA applied for 60 minutes
DeKoven et al. (2017): Canada	Retrospective Case Series (IV)	Chart review	n=6 cases of nail salon technicians with diagnosed ACD	HEMA + in 6 (100%) of patients Ethyl Acrylate + in 3 (50%) of patients MMA + in 1 (16.7%) of patients	Dorsal hands (n=5) Palm (n=2) Forearm (n=3) Fissures of fingertips (n=4) Less commonly: Face, periorbital region, eyelids, cheeks, posterior ears, etc.	N/A
Sanaat et al. (2021): Toronto, Canada	Cross-Sectional (II)	Survey	n=155 exposed n= 4 with work-related current rash	N/A	N/A	96% glove use
Nakagawa et al. (2019): Morioka, Japan	Case Report (IV)	Clinical exam	n=1 exposed n=1 case of contact dermatitis	EGDMA, 2-HEMA, ethyl acrylate, HEA	Itchy erythema and papules/vesicles/ fissures on her hands, fingertips, and forearm	N/A

Ma et al. (2019): East Coast (New York City, Philadelphia, and southern New Jersey), USA	Cross-Sectional (II)	Survey	n=112 exposed n=13 with skin irritation	High levels of acetone, low levels of MMA and toluene (via VOC air sampling for chemicals)	N/A	n=91 (81.3%) latex glove use n=3 (2.7%) nylon glove use
Kiec-Swierczynska et al. (2017): Poland	Cross-Sectional (II)	Survey	n=93 gave consent to undergo medical interview/examination/ additional tests vs n=77 control n=21 (23%) with work related hand skin lesions (ie, dryness/ roughness, eczematic lesions, itching/burning) vs 0 (0%) work related hand skin lesions in control group	Nickel and palladium	Most commonly on hands, fewer affecting the face, forearms, and periorbicularis areas	n=144 (99.3%) used gloves
Kawakami et al. (2017): Japan	Case Report (IV)	Clinical exam	n= 1 exposed n = 1 case of tinea corporis	Likely transmission from a client's nail or skin	Inflammatory tinea corporis affecting dorsal surface of thumb	No glove use
Minamoto (2014): Japan	Case Report (IV)	Clinical exam	n= 1 exposed n = 1 case of ACD	MMA	Severe itchy eczema around nails and onycholysis	Used nitrile rubber gloves
Kiec-Swierczynska et al. (2013): Poland	Case Report (IV)	Clinical exam	n= 1 exposed n = 1 case of ACD	2-HEMA, 2-HPMA, EGDMA, TREGDMA, 1,6-hexandiol diacrylate, 2-HEA, TREGDA	Redness and oozing skin lesions of the ears and external auditory canals, hand eczema, and bullous lesions on fingers	Used latex gloves
Andersen et al. (2009): Denmark	Case Report (IV)	Clinical exam, patch testing	n= 1 exposed n = 1 case of hand eczema with severe pulpitis and nail plate dystrophy	Benzoyl peroxide, MMA, 2-HEMA, Tripropylene glycol diacrylate	Hand eczema with severe pulpitis and nail plate dystrophy	N/A
Torres et al. (2005): Spain	Case Report (IV)	Clinical exam, patch testing	n= 1 exposed n = 1 case of ACD	EA, EGDMA, EMA, HEMA, MMA, TREGDMA	Dermatitis of nail folds and fingertips	N/A

Abbreviations: 2-HEMA (2-Hydroxyethyl Methacrylate), EGDMA (Ethylene Glycol Dimethacrylate), EMA (Ethyl Methacrylate), HEA (Hydroxyethyl Acrylate), 2-HPMA (2-Hydroxypropyl Methacrylate), TriEGDA (Triethylene Glycol Dimethacrylate), MMA (Methyl Methacrylate), VOC (Volatile Organic Compounds), EA (Ethyl Acrylate), TREGDMA (Triethylene Glycol Dimethacrylate)

Table 2. Location of ACD involvement.

Total cases with ACD (N)	117
Anatomic Distribution, N (%)	
Hands	79 (67.5%)
Fingertips	31 (26.5%)
Palms	30 (25.6%)
Face	30 (25.6%)
Forearms	6 (5.1%)
Neck	6 (5.1%)
Eyelids	2 (1.7%)

Abbreviations: ACD (Allergic contact dermatitis)

ditions experienced by nail salon workers in addition to the specific products, exposures, and safety practices, if any, that are utilized. Such research can better identify gaps in protocol implementation, provide further justification for increased governmental funding for community-based safety initiatives, and ultimately improve the overall working conditions in nail salons.⁴²

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Table 3. Chemicals identified in studies with association to skin irritation.

Studies identifying acrylate as the possible inciting chemical factor (N)	12
Most commonly mentioned acrylates in studies, N (%)	
2-HEMA	8 (66.7%)
EGDMA	6 (50.0%)
2-HEA	5 (41.7%)
MMA	5 (41.7%)

Abbreviations: 2-HEMA (2-Hydroxyethyl Methacrylate), EGDMA (Ethylene Glycol Dimethacrylate), 2-HEA (2-Hydroxyethyl Acrylate), MMA (Methyl Methacrylate), 2-HPMA (2-Hydroxypropyl Methacrylate)

Potential conflicts of interest

SIBJ has received honoraria or grants for Regeneron. The remaining authors declare no conflicts of interest.

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