

Preventing Occupational Skin Disease: A Review of Training Programs

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Occupational contact dermatitis (OCD) is a common occupational disease that impacts a variety of worker groups. Skin protection and disease prevention training programs have shown promise for improving prevention practices and reducing the incidence of OCD. This review details the features of training programs for primary prevention of OCD and identifies gaps in the literature. Twelve studies were identified for in-depth review: many studies included wet workers employed in health care, hairdressing, cleaning, and food preparation; 1 program featured manufacturing workers. Few programs provided content on allergic contact dermatitis, and only 1 was evaluated for long-term effectiveness. Effective programs were similar in content, delivery method, and timing and were characterized by industry specificity, multimodal learning, participatory elements, skin care resource provision, repeated sessions, and management engagement. Long-term effectiveness, generalizability beyond OCD, workplace health and safety culture impact, and translation of programs in the North American context represent areas for future research.

Occupational contact dermatitis (OCD) is the most common occupational skin disease (OSD) in many developed countries.¹ Occupational contact dermatitis has a significant impact on worker health and quality of life, workplace function, and health service utilization.²⁻⁴ Wet work is a major risk factor for developing OCD, a disease that is most common among wet workers employed in health care, hairdressing, food preparation, and cleaning work.^{2,5} With OCD, recurring symptoms are common, and many workers experience impaired function despite treatment, time off, and change of work.⁶ Because prognosis varies widely, primary prevention is of utmost importance.⁷

Prevention of OCD includes a hierarchy of measures involving primary, secondary, and tertiary strategies (Fig 1).⁸ Educational and training interventions are included at the primary prevention level to avert development of disease. Primary prevention training programs should deliver relevant information on hazard identification and seek to raise awareness about recognition of early signs of disease.⁹ Secondary prevention focuses on early recognition of workers with disease, and interventions are often designed to

prevent the progression of disease.² Interventions at the tertiary prevention level apply to workers with severe and chronic cases of OCD that result in significant impairment; these interventions involve education about work reintegration, job continuation, and prevention of disability.¹⁰

Reviews have focused on the broad prevention of contact dermatitis,¹¹ OCD,^{3,12} and occupational irritant dermatitis.¹³ Saary and colleagues¹¹ identified a need for studies on educational interventions for OCD. Nicholson and colleagues² found evidence to support the use of worker training programs to reduce the incidence of OCD and moderate evidence for targeted educational interventions to induce behavioral changes. A systematic review of prevention programs for hand dermatitis found moderate evidence for the effectiveness of prevention programs for lowering incidence and improving adherence to preventive measures.¹⁴ Although these reviews refer to training broadly, none have specifically addressed training as it relates to the prevention of OCD. This review summarizes primary prevention training interventions for OCD.

METHODS

The MEDLINE, CINAHL, and Cochrane databases were searched from January 1986 to August 2016 for English-language articles pertaining to training programs for primary prevention of contact dermatitis. The key search terms were as follows: “contact dermatitis,” “hand dermatoses,” “eczema,” “skin disease,” “education,” “training,” “occupational exposure,” “prevention,” “occupational health,” “work-related,” and “program.” Manual searches of relevant articles and reviews were conducted to obtain additional articles not captured by the initial search.

Studies featuring training interventions for primary prevention of OCD or eczema among working populations were included. A

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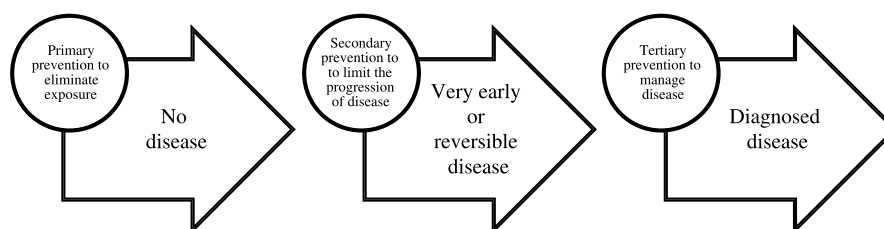


Figure 1. Points of intervention for primary, secondary, and tertiary prevention.⁸

study was excluded if the participants were not workers or already had work-related skin disease (ie, the intervention was not primary prevention), or the language of publication was not English.

One reviewer (B.Z.) extracted the data from the included studies into a matrix that included information on country of origin, study design and follow-up period, population, training and control group intervention, and relevant clinical and behavioral outcomes. Studies are organized by worker population (Table 1).

RESULTS

The peer-reviewed literature search yielded 57 articles, 47 from MEDLINE and 10 from CINAHL databases. After removal of secondary and tertiary prevention studies and duplicate articles, 5 articles were included from the initial search. Manual searching yielded 7 additional articles for a total of 12 studies included for in-depth review. Primary prevention training interventions were located only for wet workers and manufacturing workers: 4 studies featured health care workers,^{15–18} 2 included hairdressers,^{19,20} and 5 involved workers primarily in food production^{21–23} and cleaning.^{24,25} One of the 12 studies featured chemical manufacturing workers.²⁶

Details of individual program process and content, as well as outcome information, for each study are presented in Table 1. A comparison of the key skin recommendations from the different training programs is outlined in Table 2, and detailed skin recommendations are featured in Table 3.

Primary outcomes included clinically assessed morphological skin changes and self-reported symptoms to determine frequency and severity of contact dermatitis. Another measure of skin disease was barrier function indicated by transepidermal water loss. Behavioral outcomes included changes to self-reported prevention practices and exposures. Knowledge change, indicated by quiz scores, as well as changes to awareness and attitudes toward prevention, was also measured through self-report. Organizational practice changes were measured through self-reported discussion of OSD in the workplace and provision of skin care resources in the workplace. One study measured job retention as an indicator of intervention effectiveness.

The most extensive program development has occurred in Germany and Denmark. In Germany, interdisciplinary courses have been developed to educate workers with OSD by teaching theory and practical exercises to improve prognosis and prevent disease progression.²⁷ In Denmark, programs feature more applied teaching and have been developed around clinical evidence-based

recommendations, early recognition of symptoms, and practical instruction to promote skin protection.⁷

Wet Workers

Exposure to wet working conditions is a major risk factor for contact dermatitis.²⁸ Two studies used the German guideline to define wet work: more than 2 hours of skin exposure to liquid per day, glove use for more than 2 hours per day, or frequent hand washing (>20 times per day), whereas the others used the term generally.²⁹ Wet work occupations span health care, cleaning, food preparation, and other settings where the hands are in frequent contact with water.²⁸

Health Care Workers

Health care workers are at risk of developing OCD because of frequent hand washing, use of occlusive gloves, and exposure to disinfectants, rubber, latex, and topical medications.²⁷

Four studies featured interventions directed at health care workers. Two interventions were introduced among trainee nurses during their clinical training.^{15,16} The other 2 studies were implemented among established workers in nursing homes, hospitals, and a dental school.^{17,18} Training was mainly provided by nurses,^{15,18} although physicians and pharmacists¹⁵ and occupational rehabilitation specialists also acted as trainers.¹⁷ Teaching strategies included in-person lectures¹⁶; informational videos, work books, and group discussion¹⁵; and practical exercises for skin care and protection.^{16–18} Provision of skin care and protection resources such as creams, cleansers, and gloves was featured in the majority of programs.^{15,16,18} One program included participants from management,¹⁷ whereas the others targeted frontline workers. Training sessions ranged in duration from 20 minutes,¹⁸ to 2-hour sessions offered at regular intervals,^{15,17} to full-day courses for nurse managers.¹⁷ One program was repeated 3 times in the first year of nursing training and twice per year for the 3-year training period.¹⁶ Content centered around teaching evidence-based guidelines,¹⁵ workers' compensation insurance recommendations specific to health care workers,¹⁷ or occupational medicine recommendations for skin protection³⁰ (Table 3).¹⁸ Two programs included content on the physiology of the skin and the etiology of OSD and subsequently based practical recommendations on those concepts.^{15,16}

Clinical outcomes of 2 studies indicated positive effects of the training intervention as evidenced by improvements in clinically

TABLE 1. Detailed Study, Intervention, and Outcome Information

Author	Year	Origin	Population	Design	FU Period	Intervention	Outcome	Results
Health care workers Held et al ¹⁵	2001	Denmark	Student auxiliary nurses in county hospitals n = 107 (IG = 61, CG = 46)	Controlled intervention study	10 wk	Content: Evidence-based guidelines for skin protection, physiology of normal and diseased skin, causes of irritant and allergic CD, and experiences with wet work Methods: Informational video, instructional booklet, interactive dialogue Timing: Immediately prior to the start of clinical training Duration: 2 h Repetition: Twice over a 14-d period Providers: Physician, nurse, and pharmacist Resources: Moisturizer provided CG: Regular nursing curriculum	Self-reported behavior change	Significantly lower disinfectant use in the IG ($P = 0.002$) No difference between groups for amount of wet work, hand washing frequency, and the use of gloves and moisturizers Significant increase in skin symptoms in both groups ($P < 0.0005$) Significant increase in CG ($P < 0.005$) indicating impaired barrier function
							Clinically assessed skin condition TEWL	
Löffler et al ¹⁶	2006	Germany	Trainee nurses in teaching hospitals n = 325 (IG = 156, CG = 159)	Randomized controlled intervention study	18 mo and 3 y	Content: Structure and function of skin and skin hazards inherent to the nursing profession Methods: Lecture and skin protection exercises. Fluorescent technique to assess effective emollient use Repetition: 7 Times over 3 y Resources: Skin care cream provided CG: Regular nursing curriculum, skin care cream provided	Clinically assessed skin condition Self-reported behavior change	At 3-y FU, 66.7% IG vs 89.3% CG showed irritant skin changes of the hands Reduced frequency of hand washing and increased use of gloves for wet work activities in IG No difference in hand cream or disinfectant use between groups

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TABLE 1. (Continued)

Author	Year	Origin	Population	Design	FU Period	Intervention	Outcome	Results
Dulon et al ¹⁷	2009	Germany	Geriatric nurses in nursing homes n = 388 (IG = 146, CG = 242)	Randomized controlled intervention study	3 mo and 1 y	Senior nurses: Content: Risk factors for hand eczema in nursing homes and instructions for skin protection Methods: Seminar and practical instruction on skin protection Duration: 4 h Instructors: Occupational rehabilitation specialist and sector-specific insurer representatives Resources: Informational booklet and CD-ROM provided Frontline nurses: Content: Skin structure, occupational risk factors for hand eczema, and development of OCD Methods: Course included practical skin care instruction and mandatory management participation Duration: 2 h Repetition: Repeated in each nursing home until 75% of nurses had participated CG: Trained on lifting techniques and use of assistance devices	Self-reported behavior change Clinically assessed skin condition Provision of skin care products in the workplace Awareness of skin protection guidelines	Significantly increased use of moisturizers and hand disinfectant over hand washing in the IG Time spent performing wet work and glove use was unchanged Significant relative reduction in the number of cases of CD in IG (35% decrease) Increased provision of cotton gloves and barrier creams at intervention workplaces Increased in both groups
van der Meer et al ¹⁸	2014	Netherlands	Health care workers at university hospitals, general hospitals, nursing homes, and dental school n = 1649 (IG = 876, CG = 773)	Randomized controlled trial	12 mo	Content: NVAB guidelines Methods: Participants trained to increase awareness of wet work hazards and encourage adherence to NVAB guidelines among coworkers Timing: During regular departmental meetings Duration: 20 min Instructor: Occupational nurse Resources: Informational leaflet, moisturizer, cotton liner gloves, and disinfectants provided CG: Leaflet with NVAB evidence-based recommendations for the prevention of hand eczema	Self-reported hand eczema Self-reported behavior change	IG participants were significantly more likely to report hand eczema and related symptoms Significantly more frequent use of moisturizer, cotton under gloves in the IG No significant effects on amount of wet work, use of disinfectants, gloves, and body lotion, and wearing jewelry at work

HairdressersSchwanitz
et al¹⁹

2003	Germany	Trainee hairdressers in vocational school n = 185 (IG = 73, CG = 112)	Longitudinal controlled intervention	4 FUs over a 3-y study period	Content: Skin care and prevention of OSD Repetition: 6 Sessions over study period Duration: 15 h total Resources: Skin care products and gloves provided CG: No intervention (different vocational school)	Clinically assessed severity of skin changes Incidence of eczema Self-reported employment status	No skin changes were observed in 80% of IG vs 66% in CG Significantly lower in IG (19.5%) than CG (33.9%) 100% of CG unable to work due to skin problems vs none in the IG
2012	Denmark	Hairdressing instructors and apprentices in vocational school n = 502 (IG = 301, CG = 201)	Controlled intervention study	8 and 18 mo	Content: Hairdressing school instructors: Skin physiology, allergy and eczema, prevention of hand eczema for hairdressers Methods: Trained and helped develop skin protection recommendations for their students Duration: 2 d Apprentices: Content: Hairdressing-specific skin protection guidelines Methods: Oral presentations, group work exercises, and glove size measurement Resources: Moisturizer and protective gloves provided CG: Regular hairdressing school curriculum only	Clinically assessed hand eczema Self-reported glove use, degree of wet work for their students	Significantly fewer participants in the IG developed hand eczema compared with the CG ($P < 0.04$) Significantly more participants in the IG used gloves to shampoo ($P = 0.039$) and rinse-out hair dye ($P = 0.017$) than in the CG at the 18-mo FU

Food workers, cleaners, nursesHeld et al²⁴

2002	Denmark	Wet workers (nursing, kitchen, and cleaning staff) in nursing homes n = 375 (IG = 207, CG = 168)	Randomized controlled trial	5 mo	Content: Evidence-based skin care guidelines and background information to support guidelines Methods: Participatory teams of frontline workers were trained to develop written policy on a skin care program and to communicate the skin care policy to colleagues. Participants trained coworkers by arranging information meetings, making posters, or giving one-on-one instructions Instructors: A nurse from the local department of occupational health and a consultant from the employees' health service Resources: Fragrance-free moisturizer provided CG: Separate departments with no skin education intervention. Fragrance-free moisturizer provided	Knowledge quiz score Self-reported behavior	Participants in the IG had significant higher quiz scores compared with the CG ($P = 0.003$) Number of wet work hours and disinfectant use was reduced in the IG; cotton glove use was significantly increased in the IG at 5-mo FU Significantly less participants wore daily finger rings in the IG compared with the CG Frequency of hand washing, use of protective gloves and moisturizers remained unchanged Significantly fewer skin symptoms were found in the IG ($P < 0.0001$) but not in the CG ($P = 1.00$)
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TABLE 1. (Continued)

Author	Year	Origin	Population	Design	FU Period	Intervention	Outcome	Results
Flyholm et al ²²	2005	Denmark	Gut cleaners in swine slaughterhouses n = 416 (IG = 136, CG = 280)	Randomized controlled intervention study	1 y	Content: Evidence-based guidelines on prevention of work related skin problems in wet work occupations Methods: Local project groups with representatives from all levels of the organization were trained to establish an occupational health and safety management system for skin hazards. Training included lectures, discussions, reflection, homework, and feedback Duration: 1 d Repetition: 2 Sessions, 1 mo apart Instructor: Occupational health service consultant and a National Institute of Occupational Health researcher CG: No intervention in comparison departments	Self-reported hand and forearm eczema	At 1-y FU, frequency of hand eczema was significantly reduced in the IG (56.2% to 41.0%). A small, nonsignificant increase was observed in the CG (45.9%-50.2%) Significantly higher glove use in the IG compared with the CG at FU. Use of cotton gloves increased in the IG from 4.6% at baseline to 26.0% at FU ($P < 0.001$) Skin care product use increased in both groups, but remained significantly more frequent in the IG
Sell et al ²³	2005	Denmark	Wet workers in a cheese dairy n = 555 (IG = 308, CG = 247)	Controlled intervention study	1 y	Same as above	Self-reported hand and forearm eczema Self-reported behavior Self-reported discussion of skin problems in the workplace	At FU, 40% relative increase in discussion in the IG ($P < 0.005$), with no change in the CG Significant reduction of symptoms at all dairies (26% relative reduction, $P < 0.05$) Significant increase in the use of gloves and moisturizers at IG dairies Significant increase in discussion of prevention (relative increase of 50.8%, $P < 0.0001$) in the IG

Clemmensen et al ²⁵	2014	Denmark	Cleaning workers in a university hospital n = 86	Prospective 1-group before and after study	3 mo	Content: Evidence-based guidelines for skin protection Methods: Practical exercises on skin care, cleansing, and protection. Illustrations used for recognition of early signs of hand eczema. Cleaning department managers were involved in planning and participated in the course Duration: 1 h Instructors: Dermatology nurse and medical student Resources: Card with 10 evidence-based recommendations, free small samples of lipid-rich, fragrance-free moisturizers and a certificate of participation provided	Self-reported discussion hand eczema severity Self-reported behavior Knowledge quiz score	At 3-mo FU, mean HECSI score decreased from 2.8 to 1.8 (<i>P</i> = 0.002) Daily hand washings (<i>P</i> < 0.001) and hand disinfections (<i>P</i> = 0.001) decreased significantly No effect on hours of wet work, protective glove use, moisturizer use Number of correct knowledge questions increased from 6.3 to 7.3 (<i>P</i> = 0.006)
Bauer et al ²¹	2002	Germany	First-year bakers' apprentices in vocational school n = 94 (IG = 39, CG = 55)	Controlled intervention study	4 × 1 mo	Content: Skin hazards and prevention in the food processing industry, structure and function of the skin, common OSDs, and skin protection, hygiene, and care Methods: Standardized video, oral presentation, and hands-on training Duration: 1 h Repetition: 2 Times over 4-wk period Resources: Written information, barrier cream, skin care ointment, and protective gloves provided CG: No skin protection intervention	Self-reported behavior change (based on 4 structured interviews)	Uptake of skin protection behaviors differed significantly between the groups (barrier cream <i>P</i> < 0.0001, protective gloves <i>P</i> = 0.046, skin care <i>P</i> = 0.025). Barrier cream use in the IG reached 100% at the 4th FU compared with 3.2% in CG At 4th FU, the use of regular skin care reached 88.9% in the IG compared with 68.1% in the CG
Manufacturing workers								
Heron ²⁶	1997	United Kingdom	Manufacturing workers in a fine chemical plant n = 1277	Prospective 1-group before and after study	1 y	Content: Skin disorders, personal protection, OSD, and dermatitis Methods: Oral presentation, informational video, posters Instructors: Trainers from the occupational health department	New cases of OSD reported to on-site medical office	New cases fell from 70/1277 workers to 27/1277 (<i>P</i> < 0.0001) following the intervention

CD indicates contact dermatitis; CG, control group; IG, intervention group; FU, follow-up; NVAB, Netherlands Society of Occupational Medicine; TEWL, transepidermal water loss.

assessed skin condition¹⁶ and reduction in frequency of skin disease.¹⁷ In 2 studies, findings were negative for clinical outcomes—there was an increase of clinically assessed¹⁵ and self-reported¹⁸ skin disease symptoms in the intervention group. All studies demonstrated mixed results for self-reported prevention behavior change, although positive effects on behavior were demonstrated by reduced frequency of hand washing,¹⁶ increased use of gloves for wet work,¹⁶ increased use of moisturizers,¹⁸ use of disinfectants over hand washing,¹⁷ and more frequent use of cotton liner gloves.¹⁸ In 1 study, organizational changes were indicated by a significant increase in the provision of gloves and barrier cream in intervention workplaces.¹⁷ Results from these 4 studies indicate that teaching interventions anchored by practical guidelines support prevention of OCD among health care workers.

Hairdressers

Frequent contact with irritants including water, shampoos, conditioners, and cleaning products, as well as allergens in hair dyes, bleach, and perming products, puts hairdressers at risk of developing OCD.³¹

Two studies investigated the effect of training programs for skin disease prevention in the hairdressing trade. Both interventions were delivered to trainee hairdressers during their vocational schooling. Program content was delivered either by specialized educators¹⁹ or hairdressing school supervisors trained in OSD prevention.²⁰ Duration of training varied from 15 hours over 6 sessions¹⁹ to 2-day instructor training followed by student training.²⁰ One program was delivered directly to students,¹⁹ whereas the other trained school supervisors to become training instructors.²⁰ Content ranged from very broad instruction on skin care management and prevention of OSDs¹⁹ to supervisor training on skin physiology, allergy, eczema, and prevention of eczema specific to hairdressing. These supervisors contributed to the development of evidence-based recommendations specific to hairdressing (Table 3) that was later delivered to hairdressing trainees through oral presentations, informational pamphlets, group exercises, and teaching of practical protection measures.²⁰ Both interventions featured the provision of skin care and protection resources including moisturizers and protective gloves; 1 intervention offered workplace consultations in addition to the skin resources.¹⁹

Outcomes indicated positive effects of the interventions evidenced by fewer clinically assessed skin changes indicating eczema development in the intervention group,^{19,20} more frequent protective glove use while shampooing and handling bleaching products,²⁰ better attitudes toward skin care, and sustained employment in hairdressing compared with control groups.¹⁹ The Danish cohort was followed up 6 years after the intervention; however, no long-term effects of the intervention on hand eczema prevalence were found.³² Although both groups showed an improvement in protective work habits, the authors reported that the intervention and control groups were no longer well matched. These results indicate that vocational school may be the

appropriate setting for skin disease prevention training in the hairdressing industry.

Food Preparation and Cleaning Workers

In addition to frequent hand washing, food workers may be exposed to irritants and allergens found in the kitchen. Cleaners are at risk of OCD from exposure to detergents, disinfectants, cleansing and preserving products, and rubber gloves.²⁹

Five articles detailed training approaches to prevent OCD in food industry workers and cleaners. Approaches ranged in setting from actual workplaces—retirement homes, slaughterhouses, dairies, and a hospital—to a vocational school for bakers. Three programs used a participatory approach where teams of frontline workers were trained to deliver skin protection information to their coworkers.^{22–24} The central feature of the majority of the interventions^{22–25} was evidence-based guidelines for skin protection with 2 programs featuring recommendations tailored to wet workers (Table 3).^{22,23} The training interventions ranged in duration from 1-hour sessions offered once²⁵ or twice,²¹ to two 2-hour sessions 2 weeks apart,²⁴ or 2 full work days 1 month apart.^{22,23} All programs featured oral presentations; other teaching strategies included group discussions and journaling,²⁴ written instructions and hands-on exercises,^{21,24,25} illustrations,²⁵ and informational videos.^{24,25} Most interventions included the provision of skin care resources.^{21,24,25} Training providers were nurses or medical students,^{24,25} occupational health consultants, and members of the research team.^{22,23} All the programs that were implemented in workplaces engaged management through manager program participation, planning, or monitoring.^{22–25}

Outcomes demonstrated positive results in terms of knowledge increases after intervention,^{24,25} better skin condition or fewer skin symptoms,^{23–25} and reduction in hand eczema frequency.²² Results for behavior change were mixed; however, positive results were demonstrated for reduction of wet work hours,²⁴ reduced use of disinfectants,^{24,25} and increased use of cotton gloves,^{22,24} protective gloves,^{22–24} skin care products,^{21–23} and barrier creams.²¹ These results indicate that participatory teams of frontline workers can effectively deliver information to prevent eczema among their coworkers.

Manufacturing Workers

Depending on industry, manufacturing workers may be at risk of OCD by exposure to solvents, preservatives, resins, and lubricants, as well as dusts, gases, vapors, fumes, and chemical by-products.²⁹

Only 1 program featured training for manufacturing workers.²⁶ The intervention was delivered on site to workers at a chemical manufacturing plant. Content included a general introduction to OSD, a short video entitled “Dermatitis and You,” and regularly updated posters displaying information about skin disorders, personal protection, and dermatitis. The program was presented by trainers from the site occupational health department. All workers reported skin problems to the on-site medical center

TABLE 2. Comparison of Recommendations for Skin Protection

Recommendation	Danish Evidence-Based Skin Protection Program	Evidence-Based Program Modified for Wet Workers	Skin Protection Program for Hairdressers	BGW Recommendations for Health Care Workers	Netherlands Society of Occupational Medicine (NVAB) Guidelines
Featured in	Held et al, ¹⁵ 2001; Held et al, ²⁴ 2002; Clemmensen et al, ²⁵ 2005	Flyvholm et al, ²² 2005; Sell et al, ²³ 2005	Bregnhøj et al, ²⁰ 2012	Dulon et al, ¹⁷ 2009	van der Meer et al, ¹⁸ 2015
Country of origin	Denmark	Denmark	Denmark	Germany	The Netherlands
Hand washing	+	+	—	+	—
Protective gloves	+	+	+	+	+
Type	—	—	+	+	—
Duration of use	+	—	+	+	—
Condition	+	+	+	—	—
When to use	+	+	+	+	+
Cotton gloves	+	+	+	+	+
When to use	+	—	—	+	+
Jewelry	+	+	+	+	+
Moisturizers	+	+	+	+	+
Type	+	+	+	—	—
How to apply	+	—	—	+	—
When to apply	+	+	—	+	—
Disinfectants	+	+	—	+	+
When to use	—	+	—	+	+
Barrier creams	—	—	—	+	—
When to use	—	—	—	+	—
General	+	+	+	+	+
Wet work	—	+	+	+	+
Housework	+	—	—	+	—
Outdoor work	+	—	+	—	—
Industry specific	—	+	+	+	—

BGW indicates *Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege* (German for Professional Association for Health Services and Welfare).

throughout the study period, and the incidence of OSD was evaluated 1 year before and after the intervention.

Results indicated a significant decline in new cases of OSD in the year after the intervention. New cases fell from 70 of 1277 workers to 27 of 1277 workers. After adjusting for chemicals handled, observer bias, and changes in reporting, the decline in OSD was attributed to the worker education intervention. This outcome indicates that effective training may be provided on site in some manufacturing settings.

DISCUSSION

Outcomes Assessment

Studies measured a variety of outcomes at different points along a continuum of behavior change and impacts downstream of training outcomes. Understanding process-related training effects such as changes in awareness, attitude, knowledge, and motivation; output-related effects such as changes to exposures, prevention, and organizational practices; and clinical impacts such as reduction in symptoms of disease, is important to evaluating the effectiveness of training programs.³³ This variety of outcomes created a challenge in comparing effectiveness across training programs.

Common Features of Effective Interventions

Timing and Location

Several interventions targeted students and apprentices in vocational school settings.^{19–21} By intervening early, workers develop prevention awareness prior to work placement and possible exposure. Because these trainees often represent young workers who face greater risks of occupational injury and disease than established workers, effective training at this career stage is crucial.³⁴ All other interventions were directed at workers in their actual workplaces. Program delivery in actual workplaces is important because it enables programs to target specific work sites and job tasks and may indicate meaningful management commitment and involvement in health and safety.³⁴

Media and Teaching Strategies

All programs delivered educational content using a combination of media and different teaching techniques including oral lectures, videos, posters, illustrations, and written instructions. Multimodal training accommodates a variety of learning styles, which may increase comprehension among a wide worker audience.⁷

TABLE 3. Educational Training Program Content—Key Skin Recommendations

Categories	Danish Evidence-Based Skin Protection Program	Evidence-Based Program Modified for Wet Workers	Skin Protection Program for Hairdressers	BGW Recommendations for Health Care Workers	Netherlands Society of Occupational Medicine (NVAB) Guidelines
Featured in	Held et al, ¹⁵ 2001; Held et al, ²⁴ 2002; Clemmensen et al, ²⁵ 2005	Flyholm et al, ²² 2005; Sell et al, ²³ 2005	Bregnhøj et al, ²⁰ 2012	Dulon et al, ¹⁷ 2009	van der Meer et al, ¹¹⁸ 2015
Country of origin	Denmark	Denmark	Denmark	Germany	The Netherlands
Hand washing	Wash your hands in lukewarm water. Rinse and dry your hands thoroughly after washing.	Wash your hands in cool water, rinse off the soap thoroughly, and dry your hands carefully with a soft material afterward.		Hands should be washed only when they are visibly dirty.	
Protective gloves	Use protective gloves when starting wet-work tasks. Protective gloves should be used when necessary but for as short a time as possible. Protective gloves should be intact and clean and dry inside.	Use protective gloves for wet and dirty working procedures, if possible. Protective gloves must be intact, clean, and dry inside and must be worn on clean, dry, and well-cared-for skin.	Use gloves when you wash, dye, bleach, and perm. Disposable gloves must be clean, new, and dry. Never reuse disposable gloves. Use gloves for as long as necessary, but as shortly as possible.	Protective gloves with long cuffs should be used generally when starting wet work tasks, eg, washing patients. Chemical-resistant gloves should be used for cleaning tasks.	Wear gloves when performing wet work.
Cotton gloves	When protective gloves are used for more than 10 min, cotton gloves should be worn underneath.	Use fabric gloves, eg, cotton gloves underneath the protective gloves.	Use cotton gloves underneath protective gloves.	Protective gloves must not be worn for longer periods than necessary. When protective gloves are used for a longer time, cotton gloves should be worn underneath.	Wear cotton undergloves when wearing gloves for longer than 10 min.
Jewelry	Do not wear rings at work.	Do not wear finger rings, jewelry, or wristwatch on hands or forearms during work.	Do not wear rings when you work.	Jewelry on the hands or wrists should not be worn during work.	Do not wear jewelry at work.
Moisturizers	Apply moisturizers on your hands during the working day or after work. Select a lipid-rich moisturizer free from fragrances and with preservatives having the lowest allergen potential. Moisturizers should be applied all over the hands including the finger webs, fingertips, and back of the hand.	Use a skin care product when needed during the working day and always after work. Use a skin care product before wet and dirty working procedures if you do not use protective gloves. The skin care product should have a high content of petrolatum and a low content of water.	Use an unscented lipid-rich moisturizer.	Moisturizers should be used as postexposure skin care as often as possible during the working day and after work. Moisturizers should be applied all over the hands, including between the fingers, on the fingertips, and on the back of the hand.	Use a moisturizer on a daily basis, and do not use a body lotion.

Disinfectants	Do not use disinfectant agents unless they are recommended for special hygienic reasons.	When hands are not visibly contaminated, alcohol-based hand disinfectant may be used as a substitute for hand washing.	Hand disinfectants should be used before and after contact with patients.	When there is no visible contamination of the hands, use an alcohol-based hand disinfectant instead of water and soap to disinfect the hands.
Barrier creams			Barrier creams should be used prior to exposure (eg, when moisture-proof gloves have to be worn for a long period) to prevent skin damage caused by irritants.	
General considerations	Take care also when doing housework; use protective gloves for dishwashing and warm gloves when going outside in winter.	Avoid or reduce wet and dirty manual working procedures. Protective gloves, hand soaps, skin care product, and hand disinfectants should be without known irritant and allergic substances or with lowest possible content thereof.	Cut before you dye the hair. Mix in a separate, ventilated cabinet. Use gloves when doing wet work in your spare time. Use warm gloves outside when it is cold.	Manual wet working procedures should be reduced if possible. Take care when doing housework; use protective gloves for dishwashing and gardening. Perform as little wet work as possible.

Content

Interventions that featured theoretical information on OCD, hazard recognition, and exposure avoidance seemed to provide a foundation of knowledge upon which to base recommendations and practical exercises. Practical instruction on the use of gloves, moisturizer, and hand cleansing appeared to be an effective educational strategy when combined with teaching guidelines for skin protection (Table 2).

Provision of Supplies

Among the programs that recommended specific protection measures, the provision of gloves, moisturizers, and disinfectants was necessary for effective skin care in the workplace. Agner and Held⁷ recommend that moisturizers and gloves be freely available in the workplace if workplace skin protection programs are to be successful. van Gils and colleagues¹⁴ advise that ensuring the availability of skin resources and protective equipment improves adherence to training recommendations.

Targeted Recommendations

Interventions featuring recommendations modified for specific worker groups, as opposed to generic skin protection guidelines, enabled targeting of information to a specific occupation, industry, or work site, to improve impact. Program content that is highly relevant to a worker's daily tasks is crucial to the success of training interventions and is what workers desire.^{7,35}

Repeated Sessions

Most interventions featured repetition of training sessions^{16–23} or follow-up using posters.^{15,18,26} This reinforcement of training maintains attention to the program and promotes continued awareness of hazards and prevention practices.⁷

Management Engagement

Prevention behavior is predicted by both training received and organizational factors related to workplace health and safety.³⁶ These factors include policies and management practices that influence a worker's perception of employer attitudes toward health and safety.³⁶ Management commitment to health and safety is integral to the success of workplace health and safety interventions.³⁷ Workers are sensitive to the perceived employer motivations for providing training, and this impacts workers attitudes and values toward training.³⁵ Several interventions reviewed were designed to engage audience at both the individual and organizational levels; this engagement may have favored a shared culture of prevention in the workplace.

Worker Engagement

Many programs took a participatory approach in training small groups of workers or supervisors to act as role models.^{18,21–25}

These interventions empowered frontline workers to take an active role in health and safety by enabling ownership for training and leading by example among their coworkers.¹⁸

Knowledge Gaps and Future Research

Large, long-term, and follow-up studies are needed to confirm the effectiveness of training interventions over time.¹³ Four of the 12 studies had follow-up periods of 4 months or less, and 5 of the 12 studies were 1 year or less in length. There was a small-group 6-year follow-up study; however, the groups were no longer well matched based on atopic disposition.³² In this study, the authors noted the challenge of attributing long-term change in OCD prevalence and work practices to a controlled educational intervention because information spreads over time. Despite these challenges, there is still a need for long-term studies of training intervention effectiveness.

There is also a need for more program evaluations in actual workplaces to determine whether training interventions can be successful outside a research context or educational environment. Programs undertaken by trainees in vocational schools and institutions where training, teaching, and learning are high priorities may not be representative of the culture of health and safety in a typical workplace. Although trainees are an important target population, future studies should focus on evaluation of training interventions among new workers in actual workplaces.

However, because workplaces vary in size and available training resources, the ideal setting of training may vary by industry. In certain industries, such as hairdressing or food preparation, workplaces tend to be small and may have less support to provide training in the actual workplace. In this context, training may need to be provided in the vocational school setting. The 3 studies in this review that were implemented in vocational schools were well suited to the potential resource level and size of participants' future workplaces. In contrast, well-resourced, possibly unionized workplaces such as hospitals and large manufacturing sites may have the infrastructure and support to provide training on site. Future research should explore the most effective setting for training provision in a variety of sectors.

There is little information in the literature related to health and safety training effectiveness in the context of workplace health and safety culture, perhaps, in part, because most studies are not undertaken in actual workplaces. Five interventions directly engaged management in the workplace, devising a program specific to managers,¹⁷ working with managers to plan the program,²⁵ or having managers establish an occupational health management system dedicated to skin hazards.^{22–24} These approaches address the need for managerial support to build a culture of health and safety in the workplace. In addition, 5 studies integrated a participatory element in the implementation strategy.^{15,18,20–23} Workers with contact dermatitis have indicated the value of a trusted supervisor providing or embodying workplace training.³⁵ Utilizing the influence of workers in a supervisory role, these interventions

further support a favorable culture for successful application of training in the workplace.³⁸ Occupational health and safety culture should be considered as a predictor of the success of interventions. Interventions that are well designed may risk failure in workplaces that are culturally ill-equipped to support ongoing prevention practices.^{39,40} There is a need for more research into the role of organizational health and safety culture in success of training programs.

Many of the programs reviewed featured recommendations targeted to the prevention of irritant contact dermatitis with little content on contact allergy. There is a need for evaluation of programs featuring content on allergen exposure especially among workers who are at increased risk of allergic contact dermatitis such as hairdressers, bakers, metal workers, tannery workers, and others.⁴¹

Finally, all of the studies reviewed were conducted outside North America. It remains to be seen whether the German and Danish approaches are translatable to other jurisdictions including North America. There is a need to develop and evaluate training interventions for OCD, with consideration for cost-effectiveness, in North America.

Strengths and Limitations

This was not a systematic review, nor did we perform a search of the gray literature; however, we are unaware of other interventions not captured in our search of the English-language literature. Limiting our search to articles published in English may have excluded relevant studies published in other languages.

Because the programs featured in this review contained multiple interventions, it was not possible to determine which specific element of each program or program delivery method was most effective. In particular, we were unable to elucidate the role of organizational culture in program efficacy.

In this review, we focused our search to primary prevention (Fig. 1). There are a number of very similar secondary prevention interventions^{19,42–49} developed to prevent disease progression and very few tertiary preventions^{19,50} strategies to improve management of OCD; however, analysis of such programs was beyond the scope of this review.

CONCLUSIONS

This review identified several primary prevention training interventions that demonstrated the prevention of OCD among wet workers in a variety of sectors, as well as manufacturing workers. Effective primary prevention programs shared similar content but differed in framing for specific audiences. These programs are characterized by industry-specific recommendations, multimodal learning, provision of skin care resources, repeated offerings, and whole organization engagement. More research is needed to determine programs' long-term effectiveness and general applicability of program structure beyond OCD, the role of organizational culture and participatory action in program success, and translation of these programs into a North American context.

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