

Exposure to wet work in working Australians

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Summary

Background. The Australian National Hazard Exposure Worker Surveillance (NHEWS) Survey 2008 was a cross-sectional survey undertaken by Safe Work Australia to inform the development of exposure prevention initiatives for occupational disease. This is a descriptive study of workplace exposures.

Objectives. To assess the occupational and demographic characteristics of workers reporting exposure to wet work.

Methods. Computer-assisted telephone interviews were conducted with 4500 workers. Two wet work exposure outcomes (frequent washing of hands and duration of time spent at work with the hands immersed in liquids) were analysed.

Results. The response rate for the study was 42.3%. For hand-washing, 9.8% [95% confidence interval (CI) 8.9–10.7] reported washing their hands more than 20 times per day. For immersion of hands in liquids, 4.5% (95% CI 3.9–5.1) reported immersion for more than 2 hr per day. Females were more likely to report exposure to frequent hand-washing than males [odds ratio (OR) 1.97, 95% CI 1.49–2.61]. Workers in the lowest occupational skill level jobs were more likely to report increased exposure to hands immersed in liquids than those in the highest (OR 6.41, 95% CI 3.78–10.88). Workers reporting skin exposure to chemicals were more likely to report exposure to hand-washing (OR 3.68, 95% CI 2.91–4.66) and immersion of the hands in liquids (OR 4.09, 95% CI 2.92–5.74).

Conclusions. Specific groups of workers reported high levels of exposure to wet work. There were differences between the profiles of workers reporting frequent hand-washing and workers reporting increased duration of exposure to hands immersed in liquids. We also found a high correlation between wet work and chemical exposure.

Key words: allergic; chemicals; irritant; occupational contact dermatitis; wet work.

Occupational exposure of the hands to liquids, either through frequent hand-washing or through immersion of the hands in liquids, is known as 'wet work.' Previous

studies have found a high frequency of hand-washing at work and prolonged duration of exposure to liquids to be associated with occupational contact dermatitis of the hands (1, 2). There are a number of occupations in industries such as health care, food and hospitality and manufacturing that are associated with an increased risk of occupational contact dermatitis. These are often characterized by a higher level of exposure to liquids. However, little information is available regarding the patterns of exposure to liquids in the general working population, through either self-reported data or objective observation. Anveden et al. reported on a Swedish study

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of 18 267 workers that found the following: 7% reported water exposure of more than 2 hr per day and 6% reported frequency of exposure of more than 20 times per day, women were exposed more than men within the same jobs, and younger workers were exposed more than older workers. The authors stressed the importance of reporting both frequency and duration of exposure (3).

The best international estimate for the incidence rate of occupational contact dermatitis obtained from a population-based study is 6.7 per 10 000 workers (4). Reporting schemes using medical practitioners as voluntary reporters give incidence rates between 1.3 per 10 000 workers in the UK and 15 per 10 000 workers in The Netherlands (5). An Australian reporting scheme using general practitioners and dermatologists as reporters estimated an incidence rate of 2.2 (95% confidence interval (CI) 1.3–3.2) per 10 000 workers and a 1-year period prevalence rate of 3.5 (95% CI 2.4–4.8) per 10 000 workers (6). Adequate information regarding levels of exposure in specific occupational contexts, such as small businesses, or industries that are most at risk of elevated exposure, is required by workers, employers and policy-makers to enable the development and implementation of appropriate work health and safety policy (7). This paper presents exposure data from the Australian National Hazard Exposure Worker Surveillance (NHEWS) survey. In this analysis, we identify the occupational and demographic characteristics of workers who reported exposure to wet work, with the aim of providing information to target policy and practice responses.

Materials and Methods

Study population and design

In 2008, Safe Work Australia conducted the NHEWS survey, which collected self-reported occupational exposure data from Australian workers by the use of computer-assisted telephone interviews. Information was collected for a range of occupational hazards, including sun exposure, noise, vibration, dusts, gases, fumes and vapours, biological materials, wet work, chemical substances, and psychosocial hazards (8). The survey used an industry quota-based sampling technique, and obtained an Australia-wide sample of workers across all industry groups defined by the Australian Bureau of Statistics (ABS) (9), with an emphasis on five Australian National Priority Industries – ‘manufacturing,’ ‘construction,’ ‘agriculture, forestry and fishing,’ ‘transport and storage,’ and ‘health and community’ services – as determined by Safe Work Australia. The industry quota-based sampling technique is described in detail elsewhere (8). Households were randomly selected with the Desk Top Marketing

Systems database, which collects its information from directories such as the White/Yellow pages telephone listings. Participants were required to have worked in the last week and to have earned money from the work.

The study was approved by the University of Sydney Human Research Ethics Committee in Sydney, Australia (#02-2008/105060).

Questionnaire

For the wet work component of the NHEWS survey, workers were asked to estimate how many times a day they washed their hands, as well as how long they spent each day with their hands immersed in liquid, and to identify the type of liquid. Questions used in the NHEWS survey regarding wet work are reported in Appendix 1.

Wet work exposure

There were two separate outcomes for wet work exposure: frequency of washing of hands, and time spent at work with the hands immersed in liquids. Workers were also asked about the main types of liquid to which their hands were exposed, and could nominate multiple types of liquid. For hand-washing, workers who reported washing their hands ≤ 20 times in a typical day at work were classified as ‘unexposed/low exposure,’ and workers who reported hand-washing > 20 times per day, but < 100 times, were classified as ‘high exposure.’ Workers who reported washing their hands ≥ 100 times per day were classified as ‘very high exposure.’ For hands immersed in liquids, workers who reported contact with liquids for ≤ 1 hr per day were classified as ‘unexposed/low exposure,’ workers who reported contact with liquids for > 1 hr but for ≤ 2 hr per day were classified as ‘medium exposure,’ and workers who reported contact with liquids for > 2 hr per day were classified as ‘high exposure.’ The categorical groups for frequency of hand-washing and time for which hands were immersed in liquids are based on the categories used by Anveden Berglind et al. (3).

Covariates

Workers were asked about their employment arrangements and the number of employees at their workplaces. Occupational skill level was collapsed into five ABS-defined skill levels (9). The highest skill level included professionals (such as registered nurses) and managers. Skill Level 2 included associate professionals, advanced trades (such as chefs), and skilled clerical staff. Skill Level 3 included trades (such as hairdressers and bakers) and technical occupations. Skill Level 4 included occupations such as intermediate sales and clerical/administrative

and service occupations (such as dental assistants, carers, and aides). Skill Level 5 included occupations such as elementary clerical and sales occupations, machine operators, and labourers (such as kitchen hands, cleaners, and laundry workers).

For the industrial sector, the base size for some industries was small, and a number of industries were combined for the logistic regression models. For chemical exposure, workers were asked for how long their skin was exposed to chemicals per day. Exposure to wet work was considered in each industrial group and, in consultation with an occupational dermatologist (R. L. Nixon), industries with similar exposures were combined. 'Transport and storage' was set as the reference category for the logistic regression models, because it was not a highly exposed or unexposed industry, and because it had a larger sample size with sufficient numbers to provide a robust reference group.

Statistical analyses

Exposure data were stratified by variables including sex, categorical age group, categorical occupational level (Level 1 highest to Level 5 lowest), number of employees in the workplace, industrial grouping, and self-reported exposure to chemicals. Percentages were calculated for categories within each of these groups. Categorical variables were compared by the use of chi-squared tests. Significance was set at the 0.05 level. Univariate logistic regression was used to determine which variables should be included in the models. Significant variables were included in the multivariate models to identify potential associations with exposure to wet work.

Odds ratios and 95% CIs are reported for the models. Multivariate logistic regression model fit was assessed with Hosmer–Lemeshow tests; all models presented had acceptable fit (test statistic >0.20). It was suspected that workers in industries who were exposed to chemicals in addition to wet work might have a different risk profile from workers in industries who were exposed to wet work without exposure to chemicals. Accordingly, all multivariate models were checked for interaction between chemical exposure and industry, and no evidence of interaction was detected. Analyses were completed with the STATA™ 10.1 statistical programme (Stata Corporation, College Station, TX, USA).

Results

The NHEWS survey obtained an Australia-wide sample of 4500 workers across all 17 industries, with a 42.3% response rate. No further information is available about non-responders.

Hand-washing

Overall, 9.8% (95% CI 8.9–10.7) of workers reported that they washed their hands >20 times per typical day at work in the week preceding the survey. There were 8.0% (95% CI 7.1–8.8%) of workers in the 'high' exposure category (washing their hands >20 times, but <100), and 1.8% (95% CI 1.4–2.2%) of workers in the 'very high' exposure category (washing their hands ≥100 times). Self-reported exposure to hand-washing is shown in Table 1. The industries with the highest percentages of workers reporting hand-washing ≥100 times per typical day were 'accommodation, cafes, and restaurants' (6.6%) and 'health and community services' (6.3%).

The results of the univariate and multivariate logistic regression model for hand-washing are shown in Table 2. The model compares the group reporting washing their hands ≤20 times per day with those reporting hand-washing >20 times per day. The multivariate logistic regression models are adjusted for all of the variables shown. One of the strongest associations was

Table 1. Exposure to wet work (hand washing) by demographic and workplace variables

Demographic and employment variables, n = 4500	Unexposed/ low	High	Very high	p-value*
Sex (n = 4500) n (%)				
Females	1664 (83.8)	256 (12.9)	65 (3.3)	<0.001
Males	2394 (95.2)	103 (4.1)	18 (0.7)	
Age group (years) (n = 4464) n (%)				
15–24	224 (89.6)	23 (9.2)	3 (1.2)	0.949
25–34	559 (89.15)	55 (8.8)	13 (2.1)	
35–44	1038 (90.3)	88 (7.7)	23 (2.0)	
45–54	1326 (90.7)	111 (7.6)	25 (1.7)	
≥55	883 (90.5)	77 (7.9)	16 (1.6)	
Occupational skill level (n = 4337) n (%)				
Level 1 (highest)	1352 (88.4)	134 (8.8)	43 (2.8)	<0.001
Level 2	364 (88.1)	41 (9.9)	8 (1.9)	
Level 3	760 (94.65)	41 (5.1)	2 (0.25)	
Level 4	980 (88.4)	107 (9.65)	22 (2.0)	
Level 5 (lowest)	449 (93.0)	28 (5.8)	6 (1.2)	
Employment arrangements (n = 3627) n (%)				
Permanent	2648 (89.5)	244 (8.25)	66 (2.2)	0.327
Temporary/casual	472 (89.4)	48 (9.1)	8 (1.5)	
Fixed term	128 (90.8)	13 (9.2)	0 (0)	
Number of employees at workplace (n = 4472) n (%)				
<5	913 (93.45)	54 (5.5)	10 (1.0)	<0.001
5–19	886 (92.7)	59 (6.2)	11 (1.15)	
20–199	1344 (88.9)	141 (9.3)	27 (1.8)	
≥200	893 (86.95)	99 (9.6)	35 (3.4)	

*Chi-square test.

Table 2. Exposure to wet work (hand-washing) by demographic and workplace variables: univariate (first column) and multivariate (second column) logistic regression, hand-washing ≤ 20 times versus > 20 times per typical day at work. Multivariate models are adjusted for all of the presented variables

n = 4500	Univariate Odds ratio (95% CI)	Multivariate Odds ratio (95% CI)
Sex		
Males (reference category)	—	—
Females	3.82 (3.07–4.75)*	1.97 (1.49–2.61)*
Number of employees at workplace		
<5 (reference category)	—	—
5–19	1.13 (0.79–1.60)	0.77 (0.52–1.15)
20–199	1.78 (1.32–2.41)*	1.49 (1.05–2.11)*
≥ 200	2.14 (1.57–2.92)*	1.44 (1.00–2.08)*
Occupational skill level		
Level 1 (highest) (reference category)	—	—
Level 2	1.03 (0.73–1.44)	1.01 (0.68–1.49)
Level 3	0.43 (0.31–0.61)*	0.91 (0.60–1.39)
Level 4	1.00 (0.79–1.28)	0.89 (0.67–1.19)
Level 5 (lowest)	0.58 (0.39–0.85)*	0.58 (0.37–0.92)*
Industry ^a		
Transport and storage (reference category)	—	—
Manufacturing	1.49 (0.81–2.73)	1.33 (0.71–2.50)
Construction/ electricity, gas, and water	0.55 (0.27–1.15)	0.57 (0.27–1.20)
Agriculture, forestry, and fishing/mining	1.74 (0.89–3.38)	1.51 (0.75–3.06)
Health and community service	10.81 (6.33–18.44)*	6.02 (3.38–10.70)*
Wholesale and retail trade	1.57 (0.74–3.32)	1.40 (0.64–3.05)
Accommodation, cafes, and restaurants	7.99 (3.95–16.17)*	5.70 (2.71–12.02)*
Finance and insurance/property and business/ communication services	0.38 (0.14–0.97)*	0.41 (0.15–1.08)
Government administration and defence	0.31 (0.09–1.09)	0.32 (0.09–1.14)
Education	0.81 (0.36–1.82)	0.52 (0.22–1.23)
Cultural, recreational and personal services	1.69 (0.64–4.48)	1.09 (0.37–3.17)
Chemical exposure		
No/low exposure (reference category)	—	—
High exposure	3.97 (3.23–4.89)*	3.68 (2.91–4.66)*
Observations	4500	4309

Table 2. Continued

n = 4500	Univariate Odds ratio (95% CI)	Multivariate Odds ratio (95% CI)
Hosmer–Lemeshow goodness-of-fit	—	$\chi^2(8) = 7.29, p = 0.5055$

CI, confidence interval.

* $p < 0.05$.

^aFor the models, the following industrial groupings have been combined: construction with electricity, gas and water; agriculture, forestry and fishing with mining; finance and insurance, and property and business services, with communication services.

among workers who also reported exposure of their skin to chemicals. These workers were three and a half times more likely to report exposure to hand-washing than workers who did not report chemical exposure. Two industries had substantially increased odds of exposure as compared with the reference industry of 'transport and storage.' Workers in 'accommodation, cafes, and restaurants' and workers in 'health and community services' were both approximately six times more likely to report increased hand-washing. Workers in workplaces with between 20 and 199 employees were more likely to report increased hand-washing. Women were almost twice as likely to be exposed as men. Workers in the lowest occupational skill level were less likely to wash their hands > 20 times per day than workers in the highest occupational skill level.

Hands immersed in liquids

Overall, 7.3% (95% CI 6.5–8.0) of workers reported their hands being immersed in liquids for more than 1 hr during the course of their work in a typical working day. There were 2.8% (95% CI 2.3–3.2) of workers in the medium-exposure group (contact with liquids for more than 1 hr but 2 hr or less per day) and 4.5% (95% CI 3.9–5.1) in the high-exposure group (contact with liquids for more than 2 hr per day). Self-reported exposure to hands immersed in liquids is shown in Table 3. 'Accommodation, cafes, and restaurants' (14.3%) was the industry with the largest percentage of workers in the high-exposure category, followed by 'health and community services' (7.7%).

In response to the question requesting identification of liquids, the most commonly reported exposure was water, with 64% of those exposed to liquids reporting exposure. Industries reporting the highest percentages of exposure to water were 'health and community services' (30%), 'construction' (14%), and 'manufacturing' (11%). The industries with the highest percentage of exposure to detergents, cleaning products and disinfectants were 'health and community services' (42%) and 'manufacturing' (9%). 'Manufacturing' was the industry

Table 3. Exposure to wet work (amount of time that hands are in liquid) by demographic and workplace variables

Demographic and employment variables, n = 4500	Unexposed/low	Medium	High	p-value*
Sex (n = 4500) n (%)				
Females	1805 (90.9)	73 (3.7)	107 (5.4)	<0.001
Males	2367 (94.1)	51 (2.0)	97 (3.9)	
Age group (years) (n = 4464) n (%)				
15–24	228 (91.2)	9 (3.6)	13 (5.2)	0.085
25–34	573 (91.4)	12 (1.9)	42 (6.7)	
35–44	1063 (92.5)	34 (3.0)	52 (4.5)	
45–54	1368 (93.6)	36 (2.5)	58 (4.0)	
≥55	907 (92.9)	33 (3.4)	36 (3.7)	
Occupational skill level (n = 4337) n (%)				
Level 1 (highest)	1487 (97.25)	14 (0.9)	28 (1.8)	<0.001
Level 2	379 (91.8)	18 (4.4)	16 (3.9)	
Level 3	724 (90.2)	27 (3.4)	52 (6.5)	
Level 4	1025 (92.4)	32 (2.9)	52 (4.7)	
Level 5 (lowest)	405 (83.85)	28 (5.8)	50 (10.35)	
Employment arrangements (n = 3627) n (%)				
Permanent	2754 (93.1)	69 (2.3)	135 (4.6)	<0.05
Temporary/casual	472 (89.4)	25 (4.7)	31 (5.9)	
Fixed term	133 (94.3)	2 (1.4)	6 (4.3)	
Number of employees at workplace (n = 4472) n (%)				
<5	891 (91.2)	38 (3.9)	48 (4.9)	0.054
5–19	885 (92.6)	19 (2.0)	52 (5.4)	
20–199	1408 (93.1)	42 (2.8)	62 (4.1)	
≥200	966 (94.1)	23 (2.2)	38 (3.7)	
Exposure of the skin to chemicals (n = 4500) n (%)				
Unexposed	2803 (97.2)	30 (1.0)	51 (1.8)	<0.001
Exposed	1369 (84.7)	94 (5.8)	153 (9.5)	

*Chi-squared test, significance set at the 0.05 level.

with the highest percentages of exposed workers for a number of liquids, including oils (28%), solvents, thinners and methylated spirit (43%), hydraulic oil (28%), degreaser (30%), and grease (28%). 'Construction' had the highest percentages of workers exposed to concrete (93%) and to paint (26%). 'Transport and storage' had the highest percentage of workers exposed to fuel, petrol, and kerosene (24%). Finally, the industry with the highest percentage of workers exposed to bodily fluids was 'health and community services' (79%).

The results of the univariate and multivariate logistic regression model for the likelihood of reporting time spent in contact with liquids are shown in Table 4. The multivariate logistic regression models are adjusted for all of the variables shown. The model compares the group reporting ≤2 hr with those reporting >2 hr. There were strong associations by occupational skill level. Workers in Level 5, the lowest occupational skill level, were almost six and a half times more likely to be exposed for >2 hr

Table 4. Exposure to wet work (time spent in liquid) by demographic and workplace variables, univariate and multivariate logistic regression, ≤2 hr compared with >2 hr per day. Multivariate models are adjusted for all of the presented variables

	Univariate Odds ratio (95% CI)	Multivariate Odds ratio (95% CI)
Sex		
Males (reference category)	—	—
Females	1.42 (1.07–1.88)*	1.24 (0.85–1.82)
Occupational skill level		
Level 1 (highest) (reference category)	—	—
Level 2	2.16 (1.16–4.03)*	2.03 (1.07–3.88)*
Level 3	3.71 (2.32–5.92)*	4.07 (2.37–7.00)*
Level 4	2.64 (1.65–4.20)*	2.40 (1.48–3.89)*
Level 5 (lowest)	6.19 (3.85–9.95)*	6.41 (3.78–10.88)*
Industry ^a		
Transport and storage (reference)	—	—
Manufacturing	1.63 (0.83–3.17)	1.40 (0.70–2.80)
Construction, electricity/gas/water supply	1.33 (0.67–2.65)	1.02 (0.50–2.08)
Agriculture, forestry, fishing, and mining	1.59 (0.75–3.37)	1.38 (0.63–3.04)
Health and community services	2.65 (1.42–4.93)*	2.92 (1.46–5.84)*
Wholesale and retail trade	0.68 (0.27–1.96)	0.39 (0.13–1.18)
Accommodation, cafes, and restaurants	5.26 (2.31–11.97)*	2.97 (1.24–7.15)*
Finance and insurance, property and business and communication services	0.55 (0.21–1.42)	0.73 (0.26–2.02)
Government administration and defence	0.39 (0.11–1.41)	0.71 (0.19–2.60)
Education	0.40 (0.13–1.25)	0.72 (0.22–2.36)
Cultural, recreational and personal services	2.13 (0.78–5.83)	1.78 (0.62–5.09)
Exposure of the skin to chemicals		
No/low exposure (reference category)	—	—
High exposure	5.81 (4.20–8.02)*	4.09 (2.92–5.74)*
Observations	4500	4337
Hosmer–Lemeshow goodness-of-fit	—	$\chi^2(8) = 7.71$, $p = 0.4625$

CI, confidence interval.

* $p < 0.05$.

^aFor the models, the following industrial groupings have been combined: construction and electricity, gas, and water; agriculture, forestry, and fishing and mining; property and business services and communication services.

per day than workers in the highest occupational skill level. Workers in Level 3 were four times as likely to be exposed. With respect to industry, 'accommodation, cafes, and restaurants' and 'health and community services' had significantly increased odds of reporting exposure as compared with the reference category of 'transport and storage.' Similar to the results for hand-washing, workers who reported exposure of the skin to chemicals had increased odds of exposure. These workers were four times more likely to be exposed.

Wet work exposure: Hand-washing and/or hands immersed in liquids

Finally, 13.1% (95% CI 12.1–14.1) of workers reported that they washed their hands >20 times per typical day at work and/or had contact with liquids for >2 hr per day.

Discussion

This study presents a first attempt to obtain information about the extent and characteristics of exposure to wet work at the Australian national level. Data from the NHEWS survey indicate extensive exposure to wet work among participating workers. This was particularly the case for hand-washing, with 1 in 10 participants reporting that they had washed their hands >20 times per typical day at work in the previous week. For immersion of the hands in liquids, 4.5% of participants reported >2 hr of immersion per typical day at work in the previous week.

Exposure to chemicals and exposure to liquids in the workplace were highly correlated, with workers reporting skin exposure to chemicals being three and a half times as likely to report higher rates of hand-washing and four times as likely to report immersion of the hands in liquids. When workers were asked to nominate the 'types of liquid' to which they were exposed, many of the substances reported by workers could clearly be classified as chemicals, providing some indication of the overlap between wet work and exposure to chemicals. Wet work and chemical exposure are known to interact in the development of diseases such as allergic and irritant contact dermatitis (10).

The main industries in which workers reported increased wet work exposure (frequent hand-washing and immersion of the hands in liquids) were 'health and community services' and 'accommodation, cafes, and restaurants'. There were increased odds of exposure in workplaces with larger numbers of employees, and this might be influenced by the number of workers, such as for nurses in 'health and community services' (where there was an increased likelihood of frequent hand-washing) working in hospitals, which are usually

medium to large workplaces. We found that workers in the lowest occupational skill level were less likely to wash their hands >20 times per day than workers in the highest occupational skill level. This is probably because nurses, who typically wash their hands many times per shift, were classified in the highest occupational skill level. This contrasts with the finding for hands immersed in water, where we found that workers in lower occupational skill level jobs were more likely to report increased exposure to hands immersed in liquids. Again, this might be influenced by workers known to be at high risk for occupational contact dermatitis, such as kitchen hands and cleaners (11, 12), being classified in lower occupational skill levels.

Although there were some similarities, as well as overlap, between workers reporting frequency of exposure (hand-washing) and the group reporting duration of exposure (hands immersed in liquids), there were also a number of differences. Workers in higher occupational skill levels were more likely to report frequent hand-washing, but workers in lower occupational skill levels were more likely to report longer duration of hands immersed in liquids. Females were more likely to report frequent hand-washing, but there were no differences by sex for hands immersed in liquids. Number of employees in the workplace was significant for both the univariate and the multivariate models for hand-washing, but number of employees in the workplace was not significant for either the univariate or multivariate model for duration of hands immersed in liquids (data not shown). These findings suggest that the two exposures have varying profiles for patterns of exposed workers. When the two exposures – frequency of exposure and duration of exposure – were combined, we found that a much larger percentage of workers reported any wet work exposure, once again suggesting that different groups of workers are reporting frequency and duration.

The NHEWS survey used an industry quota-based sampling technique, and as such cannot be considered to be strictly population-based; therefore claims of generalizability must be treated with caution. However, the underlying industry-specific data should be representative of the priority Australian industries. No analysis of non-responders was conducted for the NHEWS survey. The survey population was sampled from publicly listed telephone numbers, which may have underrepresented younger workers or workers from lower socio-economic positions. These workers may also have been more exposed to wet work, so the NHEWS exposure rates may be an underestimate of the rates of wet work in the Australian population.

Self-reported data may provide an underestimate or overestimate when compared with objective exposure measurements. Questions about the amount of time with hands immersed in liquid and how many times a day workers washed their hands have been validated internationally. In a Swedish study by Anveden et al., workers were asked to complete a questionnaire regarding wet work exposure prior to their working day. Observers using a hand-held computer then registered the total exposure time and frequency of hand-washing for each of the workers. Strong correlations were found between self-reported and observed data for durations of exposure to water, food products, and occlusive gloves, and a moderate correlation was observed for frequency of hand-washing (13). Although there was no direct validation of the questions used in the NHEWS survey, they were generally consistent with those used by Anveden et al.

The NHEWS exposure prevalence for hand-washing can be compared with that of Anveden et al., who found 6.0% of workers reporting hand-washing >20 times per day (3). For immersion of the hands in liquids, the NHEWS exposure prevalence was again similar to that of Anveden et al., who found that 7% of workers reported exposure to water for >2 hr per day (3). Although Anveden et al. specifically measured exposure to water, whereas the NHEWS survey measured exposure to 'liquids,' the similarities of these percentages suggest that the two studies found fairly consistent rates for wet work exposure in the Swedish and Australian populations, in terms of both frequency and duration.

There were many areas of congruence between the NHEWS survey and the Anveden et al. study; however, we also observed some areas of difference. In the NHEWS survey, females were more likely to report exposure to frequent hand-washing, as was the case in Anveden et al. However, in the NHEWS survey, there were no significant differences between males and females for immersion of the hands in liquids. Anveden et al. found that workers in the youngest age groups reported the highest levels of duration and frequencies for exposure, whereas there were no differences by age group in the NHEWS survey (3). These differences may be attributable to variations in the survey questions or in the underlying Swedish and Australian study populations.

In Germany, the *Technical Standards for Hazardous Substances: Skin Damage from Work in Wet Environments* (14) have been implemented since 1996. The technical standards regulate activities for employees who 'spend a large part of their work time, that is, more than one fourth of the daily shift (2 hr) with their hands in wet environments' or who 'spend a corresponding amount of time wearing moisture-proof gloves, or must frequently clean their

hands' (14). These levels of >2 hr are also specified in the Australian government guidelines, *Guidance on the Prevention of Dermatitis Caused by Wet Work* (15). As noted in the Anveden study, the exposure threshold levels for damaging skin exposure to water have not been consistently determined with experimental studies (3). The levels utilized for the NHEWS survey are based on the German technical standards and are consistent with those used by Anveden et al.

Exposure surveillance, such as that undertaken by the NHEWS survey, provides complementary information to that provided by workers' compensation claims. Previous Australian studies have found large discrepancies between the numbers of workers diagnosed with occupational contact dermatitis and successful workers' compensation claims for occupationally induced dermatitis (6, 16, 17). There are many underlying reasons for this. Medical practitioners do not always ask about workplace exposures, and thus do not recognize the contribution of the workplace to the disease (18). Even if an occupational relationship is suspected, many workers affected by occupational contact dermatitis do not claim workers' compensation or even seek medical advice, and their access to both varies widely throughout the world. Although the NHEWS survey provides details of industries and workplace settings where exposure to wet work is high, it does not provide information regarding settings with high rates of diagnosed occupational contact dermatitis, and nor does it provide information regarding successful workers' compensation claims for occupationally induced dermatitis. Further research is required to describe the workplace and demographic characteristics of workers diagnosed with occupational contact dermatitis, as well as of those who successfully and unsuccessfully claim workers' compensation.

Targeted policies and education packages are required to guide intervention for exposure to wet work within the specific workplace contexts of these high-risk industries. As mentioned above, the German *Technical Standards* (531) and the *Technical Rules for Hazardous Substances* 530 'Hairdressing Trade' were fully enforced in 1996 after a long period of consultation and implementation with employers, employees, the German hairdresser's guild, cosmetic manufacturers, and legislators. As a result of these collaborative efforts, a 10-fold reduction was seen in the numbers of incident cases of occupational contact dermatitis among hairdressers in Northern Bavaria. This success story was the result of a multidisciplinary effort between dermatologists, employer and employee groups, and policy-makers (19, 20). Data from the NHEWS survey suggest that frequency of exposure to wet work (hand-washing) and duration of exposure to wet work

(hands immersed in liquids) are separate exposures with varying exposure profiles, which require different policy and practice interventions. In addition to this, the correlation of chemical exposure and wet work observed in the NHEWS survey presents an opportunity for concerted policy efforts to achieve prevention through integrated policy and practice interventions in industrial sectors and workplace settings where both exposures are high. Findings from the NHEWS survey present an opportunity for the development of targeted policy and practice interventions that could ultimately lead to a reduction in occupational irritant and allergic contact dermatitis.

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Appendix 1. Wet work exposure questions

The specific questions relating to wet work exposure were as follows:

- (1) On a typical day at work last week, how many times did you wash your hands with water, including when using the bathroom?
- (2) On a typical day at work last week, excluding time spent hand-washing, how long did you have your hands immersed in or covered by any liquid (including water) with or without gloves?
- (3) What liquids did you have your hands covered by last week?