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INVESTIGATIVE REPORT

Self-reported Occupational Skin Exposure and Risk of Physician-certified Long-term Sick Leave: A Prospective Study of the General Working Population of Norway

Jose H. ALFONSO[1], Tore TYNES[2], Jacob P. THYSSEN[3], Jan-Øivind HOLM[4] and Håkon A. JOHANNESSEN[2]

[1]*Department of Occupational Medicine and Epidemiology, [2]Department of National Work Environment Surveillance. National Institute of Occupational Health, Oslo, Norway, [3]National Allergy Research Centre, Department of Dermato-Allergology, Gentofte Hospital, University of Copenhagen, Denmark, and [4]Department of Dermatology, Oslo University Hospital and Institute of Clinical Medicine, University of Oslo, Oslo, Norway*

Little is known about the contribution of occupational skin exposure as a risk factor for physician-certified long-term sick leave in the general working population of Norway. This study drew a cohort (*n*=12,255; response at baseline 69.9%) randomly from the general population of Norway. Occupational skin exposure (in 2009) was measured based on 5 items. The outcome of interest was physician-certified long-term sick leave ≥16 days during 2010. Statistical adjustment for psychosocial and mechanical occupational exposures was performed. Long-term sick leave was predicted by occupational skin exposure to cleaning products (odds ratio (OR) 1.7; 95% confidence interval (95% CI) 1.1–2.5) and waste (OR 2.1; 95% CI 1.1–3.7) among men, and occupational skin exposure to water (OR 1.3; 95% CI 1.0–1.6) among women. The estimated population attributable risk for occupational skin exposure was 14.5%, which emphasizes its contribution as an important risk factor for long-term sick leave. ***Key words: sick leave; occupational exposure; skin; risk factors; prospective study.***

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Jose Hernán Alfonso, Department of Occupational Medicine and Epidemiology, National Institute of Occupational Health, Pb 8149 Dep NO-0033 Oslo, Norway. E-mail: jose.alfonso@stami.no

Physician-certified sick leave, a general indicator of poor health and limited functioning, predicts future disability pension (1). Norway is the Scandinavian country with the highest expenditure due to sick leave (2), and the identification of its predictors is essential to plan preventive measures at the population level.

Associations between psychosocial and mechanical work exposures and sick leave have been identified previously (3–5). However, the impact of occupational skin exposure on physician-certified long-term sick leave (LTSL) remains largely unexplored by prospective population-based studies.

Occupational skin exposure to chemical and physical irritants are associated with an excess risk of skin problems in the general working population of Norway (6). Hence, it is of interest to explore further whether occupational skin exposure is also associated with an increased risk of LTSL.

The aim of this prospective study, based on a nationwide cohort of the general working population of Norway, is therefore to quantify the contribution of occupational skin exposure to the risk of physician-certified LTSL. A range of occupational skin exposures was assessed, and statistical adjustments were performed for several explanatory variables, such as psychosocial and mechanical work exposures.

MATERIALS AND METHODS (For more details see Appendix S1[1])

Population

The study population was based on data merged between the nationwide Survey of Level of Living – Working Conditions (Statistics Norway), and the Norwegian Labour and Welfare Administration's sickness benefit register, using the Norwegian unique personal identification number (4, 5). Respondents who were registered as being in an active employee relationship for 100 days or more in both 2009 and 2010, but without LTSL in 2009 were eligible for the prospective analyses (*n*=6,182) (Fig. 1).

Predictors and outcome

Occupational skin exposure was measured at baseline (2009) based on 5 items (Table I) that were developed by an expert group from a Nordic co-operation project (7). The outcome of the study consisted of incident cases of physician-certified sick leave for a period of 16 or more working days (LTSL) at the individual level during follow-up (2010).

Statistical analysis

Associations between occupational skin exposure and LTSL, including statistical adjustments for potential confounders and competing explanatory variables in separate models (Fig. 2), were calculated by logistic regression, obtaining odds ratios (ORs) with 95% confidence intervals (95% CIs). All analyses were carried out separately for men and women. All statistical analyses were performed using PASW Statistics (formerly SPSS), V.19.0 (IBM, Armonk, NY, USA).

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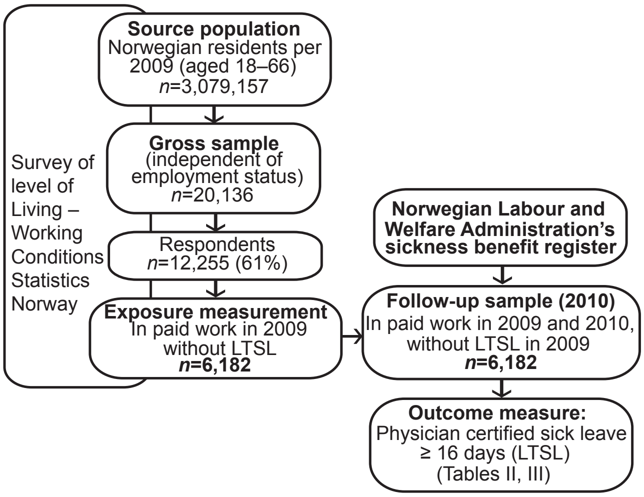

Fig. 1. Source population, random gross sample, response frequency at the baseline, and follow-up sample included in the study.

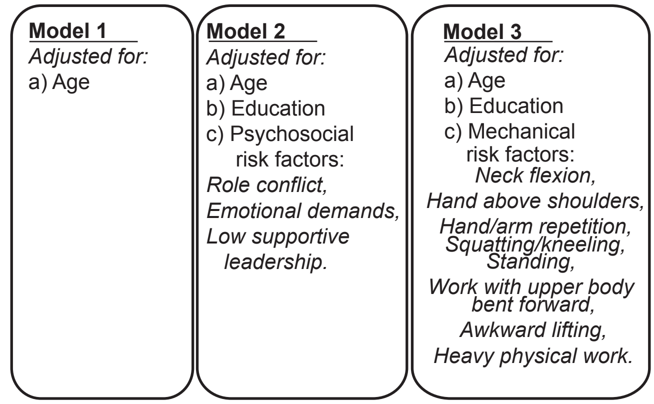

Fig. 2. Models for statistical analysis considering potential confounders and explanatory variables associated with physician-certified long-term sick leave in the general working population of Norway.

The population-attributable risk (PAR) with 95% CIs, based on the method described by Natarajan et al. (8), was calculated for occupational skin exposures that showed an association with LTSL.

RESULTS

During the follow-up 845 (13.7%) of the 6,182 participants were classified with LTSL. The distribution of socio-demographic variables at baseline with the associated risk of LTSL at follow-up is described in Table SI[1]. The risk was highest among workers in the age group 55–66 years, women, agricultural and fishery workers, and among respondents with the lowest educational level (Table SI[1]).

In the crude multiple logistic analyses, self-reported occupational skin exposures at baseline, except for biological samples for men, and oil/cutting fluids for women, were significant risk factors for LTSL at follow-up (results not shown). When adjusting for age only minor changes were observed (Table II, model #1).

Among men, self-reported occupational skin exposure to cleaning products, water, oil/cutting fluids, and waste were significant risk factors for LTSL after statistical adjustments for psychosocial work exposures and education (Table II, model #2). After adjustments for mechanical work exposures and education, skin exposure to cleaning products and waste were significant risk factors for LTSL (Table II, model #3). The risk estimates were reduced only marginally after adjustments for psychosocial and mechanical work exposures at the same time (OR 1.6, CI 95% 1.1–2.6 for cleaning products; OR 1.9, CI 95% 1.1–3.4 for waste).

Among women, self-reported occupational skin exposure to cleaning products, water, and biological samples were significant risk factors for LTSL after statistical adjustments for psychosocial work exposures and education (Table II, model #2). After adjustment for mechanical work exposures and education, water was the only significant risk factor for LTSL, while the risk estimates for cleaning products and biological samples were still elevated but were non-significant (Table II, model #3). Statistical adjustment for both psychosocial, and mechanical work exposures at the same time led to elevated and borderline significant risk estimates for women reporting occupational exposure to water (OR 1.3, 95% CI 0.9–1.7).

Based on model #3, 14.5% of the new cases with LTSL in 2010 were attributable to occupational skin exposures that significantly predicted LTSL (Table III, model #3).

DISCUSSION

This study found strong evidence of an association between self-reported occupational skin exposure to cleaning products and waste among men, and skin exposure to water among women with the risk of phy-

Table I. *Exposure assessment at baseline (2009)*

	Question	Exposures
Skin contact	Do you get water on your skin several times per hour in your day-to-day work? Including washing your hands	Water
	Are you, in your day-to-day work, exposed to skin contact with:	Cleaning products, disinfectants, solvents or other degreasing agents? Oils, lubricants or cutting fluids?
Biological factors	Are you, in your day-to-day work, exposed to biological material, for example:	Waste, e.g. garbage, offal, sewage or used disposable medical equipment? Biological samples, such as body fluids (e.g. blood, saliva, faeces or urine), or laboratory materials (e.g. biological samples from patients or animals?)

Table II. Association between occupational skin exposures measured at baseline (2009) and long-term sick leave (16 days or more) in men and women at follow-up (2010), estimated by multiple logistic regression

	Men					Women				
	N	Cases *n* (%)	Model #1 OR (95% CI)	Model #2 OR (95% CI)	Model #3 OR (95% CI)	*N*	Cases *n* (%)	Model #1 OR (95% CI)	Model #2 OR (95% CI)	Model #3 OR (95% CI)
SKIN CONTACT										
1. Cleaning products										
Unexposed	3,212	311 (9.7)	1 (ref)	1 (ref)	1 (ref)	2,390	400 (16.7)	1 (ref)	1 (ref)	1 (ref)
Exposed	224	41 (18.3)	**2.3 (1.6–3.3)****	**2.1 (1.4–3.0)****	**1.7 (1.1–2.5)***	355	92 (25.9)	**1.7 (1.3–2.2)****	**1.5 (1.1–1.9)****	1.3 (0.9–1.7)
2. Water										
Unexposed	3,084	299 (9.7)	1 (ref)	1 (ref)	1 (ref)	2,064	325 (15.7)	1 (ref)	1 (ref)	1 (ref)
Exposed	345	51 (14.8)	**1.7 (1.2–2.4)****	**1.4 (1.1–2.0)***	1.2 (0.8–1.7)	679	167 (24.6)	**1.7 (1.4–2.1)****	**1.6 (1.3–1.9)****	**1.3 (1.0–1.6)***
3. Oil/cutting fluids										
Unexposed	3,193	315 (9.9)	1 (ref)	1 (ref)	1 (ref)	2,713	487 (18.0)	1 (ref)	1 (ref)	1 (ref)
Exposed	243	37 (15.2)	**1.8 (1.2–2.6)****	**1.5 (1.0–2.2)***	0.9 (0.6–1.4)	32	5 (15.6)	0.8 (0.3–2.1)	0.7 (0.3–1.9)	0.5 (0.2–1.5)
BIOLOGICAL FACTORS										
4. Biological samples										
Unexposed	3,349	340 (10.2)	1 (ref)	1 (ref)	1 (ref)	2,291	386 (16.8)	1 (ref)	1 (ref)	1 (ref)
Exposed	85	12 (14.1)	1.5 (0.8–2.9)	1.5 (0.8–3.0)	1.2 (0.6–2.5)	453	106 (23.4)	**1.5 (1.2–1.9)****	**1.4 (1.1–1.8)****	1.2 (0.8–1.6)
5. Waste										
Unexposed	3,355	333 (9.9)	1 (ref)	1 (ref)	1 (ref)	2,535	443 (17.5)	1 (ref)	1 (ref)	1 (ref)
Exposed	81	19 (23.5)	**2.9 (1.7–5.0)****	**2.3 (1.3–4.0)****	**2.1 (1.1–3.7)***	207	48 (23.2)	**1.4 (1.0–2.0)***	1.3 (0.9–1.8)	1.0 (0.7–1.5)

In all models, respondents registered with physician-certified long-term sick leave in 2009 were excluded. Model #1: adjusted for age. Model # 2: adjusted for age, education and psychosocial risk factors at work (role conflict, emotional demands, and low supportive leadership). Model #3: adjusted for age, education, and mechanical risk factors at work (neck flexion, hands above shoulders, hand-/arm repetition, squatting/kneeling, standing, work with upper-body bent forward, awkward lifting, and heavy physical work). Significant risk estimates in bold.
CI: confidence interval; OR: odds ratio *$p \leq 0.05$; **$p \leq 0.01$.

sician-certified LTSL in the general working population of Norway. These findings are in line not only with the most common occupational exposures for work-related skin diseases notified for the period 2000 to 2013 in Norway (9), but also with occupational skin exposures shown to predict skin problems in a prospective study of the Norwegian general working population (6).

Table III. *Population attributable risk (PAR %) based on the statistically significant odds ratios (OR) from Models #1, #2 and #3 (see Table II)*

Risk factors	Model #1 PAR (95% CI)	Model #2 PAR (95% CI)	Model #3 PAR (95% CI)
SKIN CONTACT			
Cleaning products			
Men	6.5 (2.6–11.0)	6.1 (2.1–10.7)	4.5 (0.4–9.7)
Women	7.8 (3.2–12.9)	6.1 (1.1–11.4)	
Water			
Men	6.1 (1.7–11.3)	4.8 (–0.1–10.7)	
Women	14.3 (4.7–23.3)	12.8 (5.1–19.4)	7.9 (–0.9–16.7)
Oil/cutting fluids			
Men	4.6 (0.9–8.9)	3.5 (–0.3–8.0)	
BIOLOGICAL FACTORS			
Biological samples			
Women	7.1 (2.1–12.7)	6.1 (0.9–12.0)	
Waste			
Men	3.5 (1.0–6.5)	3.0 (0.5–6.2)	2.8 (0.1–6.1)
Women	2.7 (–0.25–6.6)		
Sum			14.5

Model #1: adjusted for age. Model #2: adjusted for age, education and psychosocial risk factors at work (role conflict, emotional demands, and low supportive leadership). Model #3: adjusted for age, education, and mechanical risk factors at work (neck flexion, hands above shoulders, hand-/arm repetition, squatting/kneeling, standing, work with upper body bent forward, awkward lifting, and heavy physical work).

Occupational skin exposure to cleaning products was a consistent and independent risk factor for LTSL among men. Adjustments for both psychosocial and mechanical risk factors at work did not eliminate the observed association. Our findings support results from previous studies: occupational skin exposure to cleaning products was the exposure most frequently associated with work-related skin diseases, in a Norwegian register-based study for the period 2000 to 2013 (9). In addition, occupational skin exposure to cleaning agents was associated with increased risk for skin problems in a prospective study of the Norwegian general working population (6).

Occupational skin exposure to water was an important risk factor for LTSL among women. Occupational skin exposure to water significantly predicted skin problems among women in the general working population of Norway (6) and, as in other Scandinavian countries, this might be explained by the fact that women, to a larger extent than men, hold jobs in which most of the tasks consist of wet work (10, 11).

Occupational exposure to waste for men, and biological samples for women were risk factors for LTSL. After further adjustment for psychosocial and mechanical risk factors at work, the association was observed only among men exposed to waste. To our knowledge, associations between biological work exposures and LTSL have not been reported by earlier studies from Scandinavia (12).

Sex differences regarding self-reported occupational skin exposures were thought to contribute to the higher risk for LTSL among women. However, the associations between occupational exposures and LTSL were stronger for men. For instance, the effect of cleaning products and waste on LTSL was observed only in men, yet more women were exposed. Plausible explanations for the stronger effect among men may include poor knowledge about skin care (13), lower use of moisturizers (10) and increased severity of skin conditions (14). On the other hand, household exposures shown to be risk factors for skin problems among women (11, 15) might contribute to the higher risk among women.

Psychosocial work exposures did not act as major confounders for any of the analysed associations between skin exposures and LTSL. However, adjustment for mechanical work exposures slightly attenuated the majority of the risk estimates. To the best of our knowledge, this was the first study including other occupational risk factors for LTSL when analysing the effect of occupational skin exposure on LTSL.

The validity of this longitudinal, prospectively designed study was supported by a large representative sample drawn randomly from the general Norwegian working-age population. The study included individual linkage to registered sick leave data, without loss to follow-up. The use of different sources of measures excludes the potential for common method bias (16). In addition, our objective assessments of sick leave may have reduced the subjectivity problem and increased the validity of the outcome variable. Given that our analysis included respondents without LTSL in 2009, reverse causality is not a likely explanation for the observed associations. These features lend considerable strength to the study.

The study had a moderately high response rate of 61%. Although no dissimilarities were found between respondents and non-respondents across the benchmarks of age, sex and region (17), we do not know whether people with chronic skin disorders or elevated risk of sick leave were less likely to respond at baseline. In addition, it is possible that the most vulnerable people had already left their jobs (18), and thus were excluded from this cohort. Both of these selection processes may have led to a healthy worker effect before recruitment and attenuated the risk estimates.

A particular strength of this study was the focus on individual exposure factors rather than job titles. The use of job titles as a proxy for occupational exposures may underestimate variations in exposure within occupations, or over time in the same job (19). A limitation was that the questions assessing occupational skin exposures have not been validated in a Scandinavian population, although they have been in use since 1989 (6, 7, 9, 20). For example, a Danish study assessing associations between skin exposure to cleaning agents and disability pension used almost identical questions as our study (20).

A further limitation is that the survey did not include questions on relevant skin exposures outside work. Validated questions on several skin exposures are available (19), for instance skin exposure to water. Moreover, the Nordic Skin Questionnaire is a validated questionnaire for surveying work-related skin diseases, and occupational and non-occupational exposures (21). Therefore, future population-based studies in Norway focusing on work-related skin diseases should aim at validating self-reported skin exposures at work. Nevertheless, even taking into account the risk of over- or under-estimation of reported exposures, the associations we found are in line with other Norwegian studies (6, 9) and previous knowledge (10, 15).

A weakness of our study is that, due to data protection issues, we did not have diagnoses for the physician-certified sick leave, and thus we could not address whether the sick leave episodes were, in fact, due to dermatological health problems. However, workers in wet work occupations, for the period 2010 to 2013, had the highest frequency of LTSL due to contact dermatitis in Norway, which supports the findings of our study (22). Moreover, the precision of the associations found may have been improved by the exclusion of respondents with LTSL in 2009, and adjustment for other explanatory variables shown to predict LTSL in the general working population of Norway, such as psychosocial, and mechanical risk factors at work (4, 5).

Finally, most studies have focused on the relative risk alone, without considering the proportion of employees at risk (23). Hence, the population risk of LTSL attributable to occupational skin exposures of 14.5% underlines the contribution of occupational skin exposure as an important risk factor for LTSL in the general working population of Norway.

In conclusion, this study provides evidence of an association between occupational skin exposure and LTSL for both men and women in the general working population of Norway. In future prospective studies, it would be interesting to investigate whether interventions aimed at reducing LTSL may benefit from reducing occupational skin exposures at the population level.

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