safe work australia

Occupational Contact Dermatitis:
A review of 18 years of data from an occupational dermatology clinic in Australia

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This report was prepared by J. Cahill, J. D. L Williams, M. C. Matheson, A. M. Palmer, J. A. Burgess, S. C. Dharmage and R. L. Nixon, Occupational Dermatology Research and Education Centre, Skin and Cancer Foundation Inc., Victoria, Australia

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Foreword

Safe Work Australia is an Australian Government statutory body, established in 2009, with the primary responsibility to improve work health and safety and workers' compensation arrangements across Australia. One of Safe Work Australia's main strategic goals is to achieve significant and continual reductions in work-related death, injury and disease. To this end Safe Work Australia undertakes research aimed at understanding the extent and causes of occupational disease in Australia. This research is designed and used to inform the development of work health and safety policy.

Occupational contact dermatitis was identified as a priority occupational disease under the National Occupational Health and Safety Strategy 2002-2012[1]. It accounts for the majority of cases of occupational skin disease and is one of the most common work-related problems presenting to general practitioners in Australia. Despite this, Australia has inadequate information on the prevalence of occupational skin disease, which workers are affected and the causative or contributing agents to this disease in Australian workplaces. Therefore, in line with the National Strategy, Safe Work Australia and its predecessors have conducted a range of research projects relating to contact dermatitis and other occupational skin diseases. These include national surveillance of worker exposures to wet work and chemicals, both major causes of and contributors to occupational skin disease[2].

In addition, Safe Work Australia has contributed funding to the development of Australia's first occupational skin disease database through the work of Associate Professor Rosemary Nixon of the Occupational Dermatology Research and Education Centre. This database will collate data from patch testing clinics around Australia, including demographic and employment information about workers and the allergens and irritants associated with occupational skin disease. The information provided by this database will inform policy makers on the main substances involved in occupational skin diseases, the groups of workers who are typically affected and any changes in these factors over time.

This report, the first from the occupational skin disease database, can be considered a preliminary description of the working population and substances associated with occupational skin disease in Australia. It consists of an analysis of 18 years of patch testing data from a Victorian tertiary referral clinic that specialises in occupational skin disease. The report describes patterns in the diagnosis of occupational skin diseases, examines the demographic and employment characteristics of workers with occupational skin disease and estimates the relative rates of occupational skin disease among Victorian workers. The report also lists the main allergens and irritants associated with occupational skin disease in the Victorian workforce context. The findings of the analysis of these data are discussed with reference to international studies and literature.

[1] http://www.safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications/Documents/230/NationalOHSStrategy_2002-2012.pdf

[2] Refer to the Safe Work Australia website for research publications relating to occupational skin disease: http://www.safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications/Pages/Publication.aspx

Table of contents

List of figures

List of tables

Glossary and Acronyms

ABS: Australian Bureau of Statistics.
Allergic contact dermatitis - ACD: is an itchy rash caused by a particular type of immunological reaction to skin contact with chemicals known as delayed hypersensitivity. This rash does not occur on initial skin contact with the chemical. Instead, people may become 'sensitised', which means that they will develop the rash on re-exposure to the chemical. The reaction is delayed and usually takes at least four hours to erupt and often one to two days. While there are clinical clues that can lead to this diagnosis, sometimes it may be indistinguishable from eczema. Common allergens causing this rash are metals, including nickel and chromate, preservatives in skincare products, epoxy resins, fragrances, hair dye and rubber accelerators (chemicals added to rubber during manufacturing to give it particular properties). It is tested with patch testing, where diluted substances are placed in contact with the skin of the back for 48 hours and the results read after a further 48-96 hours.
Atopy: refers to an innate propensity to develop eczema, asthma or hay fever. It can be shown that people with atopy, particularly atopic eczema, have an inherited defect of their skin barrier that makes their skin more easily irritated than normal. This makes these people more at risk of irritant contact dermatitis, especially in occupations where they are exposed to wet work.
Contact urticaria: is a less common skin rash that is caused by an immediate hypersensitivity reaction. Substances contacting the skin cause a red, itchy rash within minutes. Examples include latex (natural rubber protein) and some foods. It is the same mechanism which causes asthma and hay fever. It is tested by prick testing or radio-allergosorbent (RAST) testing of blood. In our analysis, we have considered latex allergy as a separate category, although it is also a form of contact urticaria.
Eczema: is a very common itchy skin rash. The term is often used to denote 'atopic eczema', which is an itchy rash usually appearing in infancy. Eczema may be associated with food allergies and the subsequent development of asthma and hay fever. The implication is that this rash is endogenous, that is, occurring from within, rather than caused by contact with external agents. It is thought that there is an inherited predisposition to develop atopic eczema. There are also forms of non-atopic eczema, which are unrelated to asthma, hay fever and allergies. These include discoid eczema, hand eczema, foot eczema, venous eczema, asteatotic eczema and lichen simplex. Like atopic eczema, non-atopic eczema is considered to be endogenous.
Irritant contact dermatitis - ICD: is a rash that occurs because of skin contact with irritants. It may be acute, such as cement burns from kneeling in very alkaline wet cement, or chronic, caused by exposure over time, often to a number of irritants. Skin irritants include wet work, where there is repetitive wetting and drying, which is extremely irritating to the skin; soaps, detergents, shampoos; oils; solvents; dusts and physical factors such as heat and sweating.
Occupational contact dermatitis - OCD: accounts for approximately 95% of cases of occupational skin disease (OSD). It is divided into irritant contact dermatitis (ICD) (generally more common) and allergic contact dermatitis (ACD).
Occupational skin disease - OSD: is a skin condition occurring at or aggravated by employment, generally as a result of contact with substances at work or alternatively, related to the work environment.
Persistent post-occupational dermatitis – PPOD: refers to occupational dermatitis that fails to resolve despite avoidance of the causative factors. It is usually diagnosed on follow-up, so it is an uncommon diagnosis in the clinic setting, where people present for an initial assessment of their skin condition.
Psoriasis: is a relatively common skin rash, which is generally thought to occur because of an inherited susceptibility. Occasionally damage to the skin, such as trauma or a burn, will initiate the development of psoriasis. Sometimes it can be aggravated by stress.

Executive Summary

Background
Occupational skin disease (OSD) accounts for a significant proportion of occupational disease in most countries and in many countries it is the most common occupational disease. In several countries, including Germany and Finland, registries of OSD are kept, so there is detailed statistical information available on the causes of OSD. However, there is limited information on the extent of OSD in Australia where no comprehensive or centralised recording of cases exists. It is recognised that workers' compensation statistics substantially underestimate the rates of OSD. Most cases of OSD are diagnosed as occupational contact dermatitis (OCD).

Objectives
To describe the relevant characteristics of all patients diagnosed over 18 years with OSD in a (tertiary level) specialist occupational dermatology clinic in Melbourne, Australia.

Methods
We retrospectively analysed data from all patients assessed between 1 January 1993 and 31 December 2010. These patients were referred to the clinic predominantly from dermatologists, but also from allergists, general practitioners and work health and safety personnel, because of suspicions or concerns regarding the presence of OCD. Almost all patients were patch tested to enable an accurate diagnosis of their dermatitis. Patch testing is a diagnostic process undertaken over five days to detect the presence of delayed hypersensitivity reactions involving the skin. It involves exposing the skin of the back to a set of common allergens and to other allergens likely to be encountered through work, in order to reproduce allergic contact dermatitis (ACD). If allergy is not detected, the diagnosis is often irritant contact dermatitis (ICD) or another form of skin allergy known as contact urticaria. Contact urticaria was diagnosed by radioallergosorbent testing (RAST), a blood test, particularly used to detect latex allergy, and also by prick testing.

Results
Of the 2900 patients assessed at the clinic over the study period, 2177 (75.1%) were diagnosed with OCD and of these 1208 (55.5%) were male. Atopy was present in 45.0% of patients with OCD (980/2177). ICD was the primary diagnosis in 44.0% (958/2177) of patients and ACD in 32.7% of patients (712/2177). ICD in women was significantly more likely to be caused by soaps/detergents and water/wet-work, whereas in men the most common causes were oils/coolants and solvent exposures. The most common occupationally relevant allergens were rubber accelerators, such as thiuram mix consisting of allergens tetraethylthiuram disulfide, tetramethylthiuram monosulfide and tetramethylthiuram disulfide; ammonium persulfate or hairdressing bleach; potassium dichromate in leather or cement; 4-phenylenediamine or hair dye and epoxy resin.

Conclusions
ICD was more common than ACD in our patient population. The most common occupations associated with OCD were healthcare workers and 'trades persons and labourers', while the highest rate of OCD was seen in hair and beauty workers. While our rates are not true incidence rates, they nevertheless provide relative information, particularly with respect to occupations experiencing OCD and the causative allergens and irritants in our population referred for diagnostic patch testing. The rates calculated in this study are likely to be a substantial underestimation of the true levels.

Introduction

Contact dermatitis is the most common form of occupational skin disease (OSD). Epidemiological data estimate that contact dermatitis accounts for 79-95% of all cases of OSD[1-4], with contact urticaria, folliculitis/acne, mechanical/traumatic causes and neoplasia contributing to the remainder. Some countries, for example Germany, Finland and Denmark keep registers of occupational contact dermatitis (OCD)[3, 5-8]. Our group has reviewed the epidemiology of OCD worldwide[9]. However, this was made difficult by the lack of standardisation of assessment of cases[9]. It is recommended that the criteria proposed by Mathias for the determination of work-relatedness be adopted[10]. The annual incidence of OCD has been estimated in Germany at 50-190 cases per 100 000 workers[11]. In Victoria, our group has estimated an incidence rate of 20.5 cases per 100 000 workers, based on presentation to general practitioners. We have also demonstrated that for the corresponding period, the number of workers' compensation claims was only 6.5/100 000 workers[12].

OSD is of appreciable public health importance because of its significant economic impact[13]. Estimates from the USA suggest that annual direct and indirect costs of OSD are approximately $22 million[13]. If one assumes that the number of reported cases is an underestimate of the true prevalence, then the economic costs may be substantially higher[14]. At a personal level, OSD often results in days away from work [15, 16]. In one Canadian study of 235 workers with OSD, only 33% had never missed a day of work, while 35% had been away from work for over one month[16].

Determination of atopy is an important aspect of the assessment of workers with contact dermatitis, as it has been established that atopics are more likely to experience OCD[17]. There is evidence that OCD can have a poor prognosis[18-22]. Wall and Gebauer first described persistent post-occupational dermatitis (PPOD) as on-going dermatitis for which there is no obvious present cause, precipitated by prior OCD[22]. This has now been further described[23, 24] and the financial implications for the employee and employer emphasised[25]. This highlights the possible long-lasting impact of OCD on the individual.

OSD has been identified as a priority area for research and prevention[13, 25]. The importance of OCD as the major cause of OSD has lead to widespread efforts aimed at prevention[26-29] and treatment[30-33]. Germany has introduced legislation to limit exposure to irritants[34] and European legislation limits exposure to certain allergens[35]. The success of such legislation has already been reported, including for a predominantly non-occupational allergen such as nickel[36] and an occupational allergen, such as chromate[37]. In Europe, the legislated addition of ferrous sulphate to cement has resulted in a decrease in chromate allergy in cement workers[37]. However, information on the characteristics of the patients with OCD is limited, especially in Australia. Such information is likely to assist in identifying determinants of OCD and thereby lead to appropriate preventive strategies. An audit of patient records is the most cost effective first step in investigating such determinants. Therefore, we have undertaken a review of patients seen in the Occupational Dermatology Clinic in Melbourne since its inception in 1993 until the end of December 2010.

Methodology

Patients

The study population consisted of all patients seen at the Occupational Dermatology Clinic in Melbourne, Australia between 1 January 1993 and 31 December 2010. This clinic is a tertiary referral clinic for the investigation of patients with suspected occupational dermatoses, predominantly contact dermatitis. There is no other contact dermatitis clinic in Australia that specialises in occupational cases, although occasionally workers in Victoria will be referred to the general Contact Dermatitis Clinic at the Skin and Cancer Foundation, to the clinic at Monash Medical Centre, or rarely, will be patch tested in private practice. The majority of referrals were from dermatologists, although referrals were also accepted from general practitioners, occupational physicians and

clinical medical officers, other work health staff, allergists and direct from employers. There were no exclusion criteria.

Patch testing and assignation of diagnoses

Patients were assessed through history-taking and examination and 95% of patients in this study group were assessed by the one occupational dermatologist (RN). All patients who were thought clinically to have contact dermatitis were patch tested using allergens from Chemotechnique Diagnostics® (Malmö, Sweden) and/or Trolab® Hermal (Reinbek, Germany). They were tested to an extended European standard series and to an additional allergen series compiled from the international literature. Patients were also tested with their own samples, as indicated by their occupational and personal history, prepared for testing according to De Groot[38]. Patches were applied to the back using Finn Chambers® on Scanpor® (Epitest OY, Tuusula, Finland). They were removed and read at day two or day three, and day four or five.

Positive patch tests were then assigned to be of relevance, of past relevance, or of unknown relevance, to the patients' dermatitis. In order to diagnose allergic contact dermatitis (ACD), there must be not only a positive patch test, but some history of relevant exposure that would account for the distribution of the dermatitis on the skin and its time course[31]. For example, a 30 year old cleaner was identified with a positive reaction to nickel, which was assigned to be of old relevance from contact with nickel in jewellery. The positive reaction to nickel was considered to be of no relevance to the presenting dermatitis, which was thought to be irritant contact dermatitis (ICD) caused by exposure to wet work. By convention in this case, the reaction to nickel is termed 'nickel allergy', not, 'ACD to nickel'. There is no diagnostic test for ICD. Consequently, ICD is a subjective diagnosis based on the exclusion of allergy with negative patch testing.

At the conclusion of testing, the attending physician formulated a diagnosis relevant to the patient's skin condition, which was discussed with the patient. This could include a number of different contributing factors, which were listed in order of importance. The cleaner described previously was diagnosed with first ICD, second nickel allergy, and third atopic eczema. Patients were given information relevant to their diagnoses, including in this case, a list of possible sources of nickel to avoid.

Such a process of making a diagnosis is both complex and subjective, and relies greatly on the experience of the attending physician. An extensive knowledge of possible sources of exposure to allergens is required. An algorithm is used in the clinic to facilitate the understanding of this diagnostic process and is included here (Figure 1).

Finally, patients suspected of having immediate rather than delayed skin reactions were assessed with radioallergosorbent testing (RAST), a blood test used to diagnose latex allergy, and/or prick tested to relevant immediate allergens to which they had been exposed, particularly foodstuffs. Prick testing involves placing a small amount of the suspected allergic material on the ventral aspect of the forearm and pricking the skin with a lancet (Hollister-Stier®), and comparing any resulting wheal and surrounding flare reaction to a positive control (histamine, Hollister-Stier®) and negative control (0.9% saline). Relevant positive reactions were diagnosed with contact urticaria.

Possible diagnoses

The following diagnostics categories were used: ICD, ACD, 'endogenous', which implies that the diagnosis is a form of eczema, psoriasis, latex allergy, contact urticaria, and PPOD. Atopic eczema was the major type of eczema diagnosed, but there are other forms of non-atopic eczema as well. These terms are further explained in the Glossary.

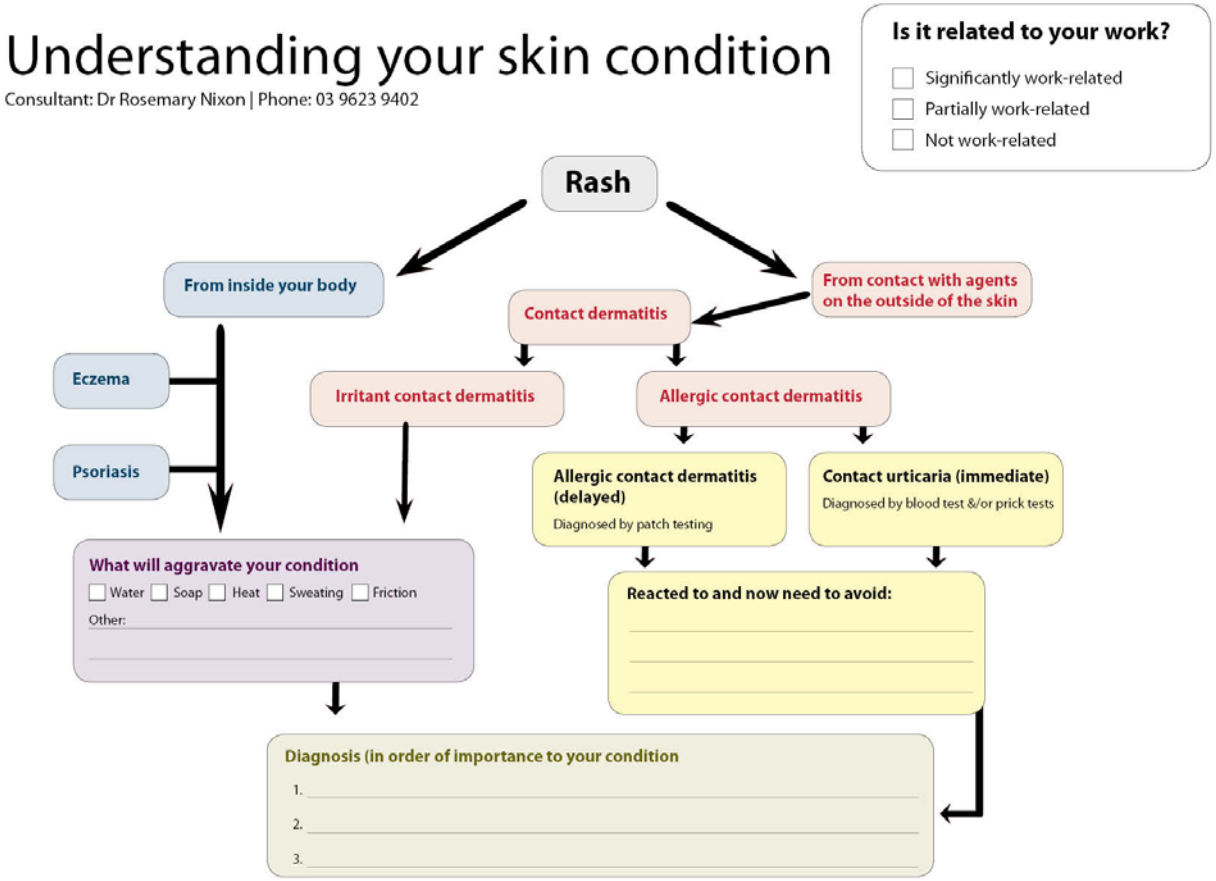

Figure 1 The clinic algorithm for understanding the diagnostic process for skin conditions

Determination of work-relatedness

An assessment was made at the conclusion of testing as to whether the condition was substantially work-related, partially work-related or not work-related. In cases of substantial work-relatedness, it was thought that work was a significant aggravating factor and that these patients were eligible for workers' compensation. This assessment was made using the criteria of Mathias[10], which are detailed in Table 1. Workers assessed with 'partially work-related' skin disease were those whose pre-existing skin disease was aggravated by work. These people invariably had underlying atopic eczema, and where work was a partial rather than significant aggravating factor, generally making them not eligible for workers' compensation in the relevant jurisdiction.

Table 1 Criteria for determining the work-relatedness of skin disease (Mathias)[10]

Criterion	Descriptor
1	Is the clinical appearance consistent with contact dermatitis?
2	Are there workplace exposures to potential cutaneous irritants or allergens?
3	Is the anatomic distribution of dermatitis consistent with cutaneous exposure in relation to the job task?
4	Is the temporal relationship between exposure and onset consistent with contact dermatitis?
5	Are non-occupational exposures excluded as possible causes?
6	Does dermatitis improve away from work exposure to the suspected irritant or allergen?
7	Do patch or provocation tests identify a probable causal agent?

Atopy

In this study, atopy was defined as a personal and family history of atopic eczema, asthma and hay fever, and was assessed by the consultant occupational dermatologist.

Classification of occupation and industry groups

The occupation of patients was classified and recorded using the Australian Bureau of Statistics' (ABS) Australian Standard Classification of Occupations (ASCO)[39]. The industry in which patients were employed was classified and recorded using the ABS' Australian and New Zealand Standard Industry Classification (ANZSIC) [40] from 2001, which was at the midpoint of the data collection period 1993 to 2010. For the purposes of this analysis nurses, nursing assistants, dentists, dental assistants, doctors and allied health professionals were grouped together as 'healthcare workers'.

Statistical Analysis

All analyses were conducted using the STATA (version 10.1; STATA Corporation Texas) statistical package. Contingency tables were analysed using Chi-square tests. Fisher's exact tests were used when one or more expected values were less than five. Potential differences between proportions were assessed using the 2-sample test of independent proportions. A p value less than 0.05 was considered as statistically significant.

Results

Demographic data

The demographic characteristics of the sample are presented in Table 2. In total 2900 patients were assessed in the clinic between 1 January 1993 and 31 December 2010. Of these, the majority were male (n=1609, 55.6%), and their ages ranged from 15 years to 82 years. Of all the patients seen, 2177 (75.1%) had a skin condition that was regarded to be substantially or partially work related. The dermatology consultant (RN) considered 41.8% (n=1210) of all patients to be atopic based on a personal or family history of asthma, eczema or hay fever. Of the 1210 atopic patients, significantly more were women (50.4% vs. 34.8%, P<0.001).

Primary diagnosis

The majority of subjects with a diagnosis which was assessed to be substantially or partially work related, were diagnosed primarily with ICD (44.0%; 958/2177), followed by ACD (32.7%; 712/2177) and endogenous eczema (10.5%, 229/2177). There was no significant difference in the diagnosis between the genders. The mean age of those with psoriasis and PPOD was slightly higher than those with other diagnoses.

Irritant contact dermatitis

In those patients with a primary diagnosis of ICD, it was regarded as substantially work related in 89.9% (862/958) cases and partially work related in 10.0% (96/958) cases. The most common skin irritants are presented in Table 3. Water and wet work were the most common cause of ICD with soap and detergents the next most common. Women were significantly more likely to have soaps/detergents (p<0.001) and water/wet-work (p<0.001) as causes of their ICD than men. Men were significantly more likely to have oils/coolants (p<0.001) and solvent exposures (p<0.001) as causes of their ICD.

More than 60% of subjects had more than one irritant as the cause of their skin condition (no cause 9.9%; one cause 30.1%; two causes 44.1%; three causes 15.8%; four causes 0.16%). Of the 958 patients with a primary diagnosis of ICD, 454 (47.4%) had an atopic background, however this was not significantly different from the rate of atopy in those with OSD (45.0%). While ICD was the primary diagnosis in 44.0% (958/2177) cases, it was an additional diagnosis in another 591, comprising 71.1% (1549/2177) of patients diagnosed with OSD.

Table 2 Demographic characteristics of subjects by primary diagnosis

	Total N (%) †	Males N (%)	Females N (%)	Age Mean ± S.D.	Age Year range
Total patients	2900 (100)	1609 (55.6)	1287 (44.4)	37.2 ± 12.8	15-82
Work related diagnosis					
Substantially	1741 (60.0)	961 (59.7)	788 (60.4)	35.7 ± 12.6	15-74
Partially	437 (15.1)	247 (15.3)	190 (14.8)	37.4 ± 12.2	16-76
Not work related	706 (24.3)	389 (24.2)	315 (24.5)	40.6 ± 13.2	15-82
Not known	16 (0.6)	12 (0.8)	4 (0.3)		
Atopic	1210 (41.8)	559 (34.8)**	648 (50.4)**	33.4 ± 11.9	15-80
Primary diagnosis in patients with OSD	2177 (75.1)				
ICD*	958 (44.0)	543 (45.0)	413 (42.7)	35.3 ± 12.3	16-70
ACD	712 (32.7)	400 (33.1)	312 (32.2)	36.6 ± 13.1	15-74
Endogenous	229 (10.5)	128 (10.6)	101 (10.4)	36.2 ± 11.4	17-63
Psoriasis	51 (2.3)	44 (3.7)	7 (0.7)	45.6 ±10.9	20-70
Latex	61 (2.8)	13 (1.1)	48 (5.0)	32.8 ± 11.7	17-60
Contact urticaria	55 (2.5)	26 (2.2)	29 (3.0)	30.6 ± 11.4	16-65
PPOD	15 (0.7)	7 (0.6)	8 (0.8)	45.7 ± 10.2	25-60
Other	74 (3.4)	41 (3.4)	33 (3.4)	38.8 ± 12.4	19-76
Unclassified	22 (1.0)				

† Percentage total number of subjects or percentage of male or females respectively

* Gender not recorded for two persons

** p<0.001

Table 3 Causes of ICD in patients with a primary diagnosis of ICD

	Number and percentage of patients: N (%)			
Irritant	**Total**	**Male**	**Female**	**P-value**
Water and wet work	368 (37.0)	106 (18.9)	262 (60.5)	<0.001
Soap and detergents	312 (32.6)	104 (18.6)	208 (48.0)	<0.001
Heat and sweating	154 (15.5)	84 (15.0)	70 (16.2)	0.54
Oils and coolants	143 (14.4)	137 (24.5)	6 (1.4)	<0.001
Solvents	139 (14.0)	116 (20.7)	23 (5.3)	<0.001
Dusts and fibres	98 (9.6)	66 (11.8)	29 (6.7)	<0.001
Acids and alkalis	41 (4.1)	36 (6.4)	5 (1.2)	<0.001
Other	213 (21.4)	146 (26.1)	66 (15.2)	<0.001
Totals	958	543	413	

Allergic contact dermatitis

ACD was diagnosed in 1135 (52.1%; 1135/2177) patients with OSD. ACD was the primary diagnosis in 712 (32.7%) cases. In patients with a primary diagnosis of ACD, it was regarded as substantially work related in 676 (94.9%; 676/712) cases and partially work related in 37 (5.2%; 37/712) cases.
The most common allergens with an occupationally relevant reaction in all patients and in those with ACD are shown in Table 4. Tetraethylthiuram disulfide, a rubber accelerator found in gloves, produced an occupationally relevant reaction in 3.1% (n=90) of all subjects clinically assessed. Figure 2 shows the total number of patients with positive patch test responses for individual allergens and the number of these that were deemed occupationally relevant. It is clear from this figure that for some allergens, the majority of positive patch test responses can be deemed occupationally relevant while for others, such as Nickel sulfate or Fragrance mix, in only a small proportion of cases are they occupationally relevant.

Table 4 Common allergens and sources of exposure

Allergens	Description	Sources of exposure
Tetraethylthiuram disulfide Thiuram mix Tetramethylthiuram monosulfide Tetramethylthiuram disulfide	Rubber accelerator- chemical added during rubber processing to influence properties of finished product	Gloves, handles, grips
Ammonium persulphate	Hairdressing bleach	Hairdressing
Potassium dichromate	Metallic salt	Used to tan leather and found in cement
4-Phenylenediamine base	Hair dye	Hairdressing, temporary tattoos
Epoxy resin	Epoxy resins and hardeners react to form epoxy compounds with specialised properties	Floor finishings, glues, marine paints
Formaldehyde	Preservative	Water-based products
2,5–Diaminotoluene sulfate	Hair dye	Hairdressing
Fragrance mix	Mixture of fragrances used for screening	Perfumes, perfumed products
Glyceryl monothioglycolate	Perming solution	Hairdressing
Coconut diethanolamide	Emulsifying agent	Cleansers, shampoos
Nickel sulfate	Metal salt	Costume jewellery
2-Nitro-4-phenylenediamine	Hair dye	Hairdressing
Basic red 46	Acrylic dye	Cheap nylon/acrylic socks
Kathon CG	Preservative	Water-based rinse-off products e.g. shampoos
2-Hydroxyethyl methacrylate, ethyleneglycol dimethacrylate	Acrylates	Dentistry, artificial nails
Colophony	Rosin	Adhesives, pine

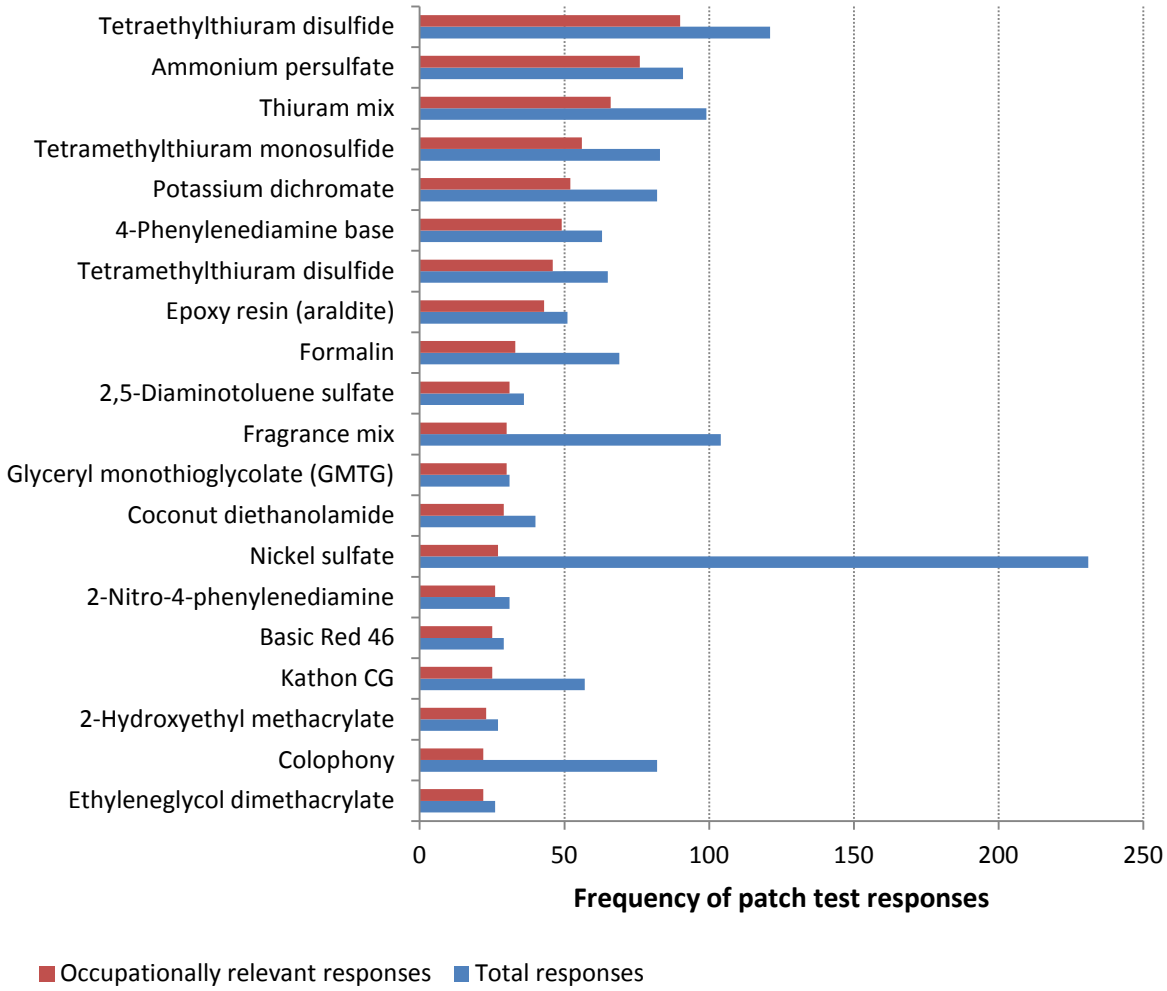

Figure 2 The total number of positive responses and the number of positive, occupationally relevant responses to the most common allergens as determined by patch testing

Occupational significance

Work was considered to be a substantial contributing factor to the skin problems of 1741 (60.0%) patients assessed at the clinic and was considered to be partially contributing to the skin problems of an additional 437 (15.1%) patients. No work contribution could be found in 706 (24.3%) patients and it was unknown in a further 16 (0.6%) patients.

Table 5 reports the occupational group for all patients with an occupationally related diagnosis stratified by primary diagnosis. More than a quarter of patients assessed in the clinic were tradespersons or related workers, followed by healthcare workers and food handlers. For those with a primary diagnosis of ICD, 23.6% were tradespersons and 24.4% were healthcare workers. Food handlers were the third most common occupational group with a primary diagnosis of ICD. For ACD, the most common occupational groups were tradespersons, hair and beauty therapists, and healthcare workers.

Table 5 The occupation of patients with OSD by primary diagnosis: percentage of patients within primary diagnosis

Occupation	Total	ICD	ACD	Endog*	Psor*	Latex	CU*	PPOD	Other
Trades persons & labourers	25.7	23.6	30.5	31.9	37.3	1.6	7.3	13.3	23.0
Healthcare workers	21.1	24.4	14.8	20.1	5.9	68.9	5.5	13.3	13.5
Food handlers	10.1	12.0	4.8	9.2	2.0	13.1	54.6	13.3	9.5
Hair & beauty therapists	8.8	5.1	16.7	4.4	0.0	9.8	1.8	0.0	6.8
Machine & plant operators	7.4	6.6	8.4	7.0	17.7	0.0	3.6	13.	9.5
Process workers & packers	4.5	4.9	3.9	3.1	7.8	0.0	1.8	13.3	10.8
Automotive workers[#]	4.2	6.8	2.4	1.8	7.8	0.0	0.0	6.7	1.4
Engineering workers[#]	3.5	4.2	3.2	2.2	3.9	0.0	1.8	6.7	5.4
Farmers	2.4	1.7	3.5	2.6	0.0	0.0	5.5	0.0	4.1
Cleaners	2.3	2.7	1.7	3.1	3.9	1.0	0.0	6.7	0.0
Science workers[#]	1.7	1.7	1.4	2.2	2.0	1.6	1.8	0.0	0.0
Cash handlers	1.3	0.9	0.8	2.2	2.0	1.6	7.3	6.7	1.4
Clerical & managerial workers	1.1	0.8	1.1	2.2	0.0	0.0	0.0	0.0	1.4
Production managers	1.1	0.3	1.8	1.8	2.0	0.0	1.8	0.0	2.7
Transport workers	0.6	0.3	0.7	0.9	5.9	0.0	0.0	0.0	0.0
Teachers	0.5	0.4	0.3	0.9	0.0	0.0	0.0	0.0	2.7
Photographic workers	0.3	0.2	0.4	0.0	0.0	0.0	3.6	0.0	0.0
Veterinary workers[#]	0.2	0.3	0.0	0.4	0.0	0.0	1.8	0.0	0.0
Childcare workers	0.2	0.1	0.3	0.4	0.0	0.0	0.0	0.0	0.0
Emergency workers-Other	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous / Others	1.7	1.6	1.9	2.2	2.0	0	1.8	0	1.4
Missing	1.4	1.2	1.1	1.8	0.0	1.6	0.0	6.7	6.8
Number of patients	2177	958	712	229	51	61	55	15	74

* Endog = Endogenous eczema, Psor = Psoriasis, CU = Contact urticaria

Automotive workers – predominantly motor mechanics, Engineering workers – predominantly metal workers & fabricators, Science workers – laboratory workers of various disciplines, Veterinary workers – veterinarians and vet nurses

Multiple contributing factors

The complexity of occupational contact dermatitis is highlighted by the fact that there are often multiple contributing factors to occupational dermatitis. Table 6 reports the frequencies of 'multiple diagnoses' in patients with significantly or partially work related dermatitis In the example of the cleaner given previously, three diagnoses were recorded: ICD, allergy to nickel and atopic eczema. It is important to identify all factors contributing to dermatitis in order to optimise clinical outcomes.

Table 6 Multiple diagnoses in patients with a substantially or partially work related condition: number and percentage of patients within diagnosed condition

Condition	Primary diagnosis N (%)	Secondary diagnosis N (%)	Tertiary diagnosis N (%)	Quaternary diagnosis N (%)
ICD (n=1,549)	958 (61.9)	498 (32.2)	87 (5.6)	6 (0.4)
ACD (n=1,135)	712 (62.7)	290 (25.6)	111 (9.8)	20 (1.8)
Contact urticaria (n=133)	55 (41.4)	41 (30.8)	22 (16.5)	14 (10.5)
Latex (n=133)	61 (45.9)	52 (39.1)	18 (13.5)	2 (1.5)
Psoriasis (n=105)	51 (48.6)	36 (34.3)	12 (11.4)	5 (4.8)
PPOD (n=54)	15 (27.8)	28 (51.9)	8 (14.8)	3 (5.6)
Endogenous eczema (n=641)	229 (35.7)	249 (38.9)	133 (20.8)	27 (4.2)
Other (n=177)	74 (41.8)	68 (38.2)	29 (16.4)	4 (2.3)
Total*	2155	1262	420	81

* Diagnosis was unclassified for a further 22 patients

Site of diagnosis

Table 7 lists the site of dermatitis for all patients seen in the clinic. The hands were the most common place for OCD. Other commonly affected areas were the arms and face. This did not change with diagnosis.

Table 7 Site of dermatitis for the three most common diagnoses: number and percentage within each diagnosis

Site of dermatitis	Total N (%)	ICD N (%)	ACD N (%)	Endogenous eczema N (%)
Hands	1897 (65.4)	771 (78.0)	566 (70.2)	276 (64.2)
Arms	521 (18.0)	199 (20.0)	163 (20.2)	60 (14.0)
Face	453 (15.6)	112 (11.3)	158 (19.6)	78 (18.1)
Legs	203 (7.0)	51 (5.1)	54 (6.7)	48 (11.2)
Feet	185 (6.4)	35 (3.5)	63 (7.8)	50 (11.6)
Eye lids	152 (5.2)	22 (2.2)	68 (8.4)	33 (7.7)
Abdomen	56 (1.9)	18 (1.8)	11 (1.4)	14 (3.3)
Back	62 (2.1)	14 (1.4)	11 (1.4)	18 (4.2)
Lips	32 (1.1)	5 (0.5)	15 (1.9)	2 (0.5)
General	44 (1.5)	5 (0.5)	3 (0.4)	13 (3.0)
Other	41 (1.4)	6 (0.6)	9 (1.1)	9 (2.1)
Total cases	2900	995	806	430

Table 8 Relative rates of OSD in Victorian occupations: cases per 100,000 workers per year within occupational group

Major occupational group	2001 ABS Victorian employment figures	Number of cases			Relative rates: cases per 100 000 workers per year		
		All OSD	ICD	ACD	OSD	ICD	ACD
Hair & beauty therapists	15 191	191	49	126	69.8	17.9	46.0
Machine & plant operators	23 475	161	64	65	38.1	15.1	15.4
Healthcare workers	124 300	460	243	116	20.6	10.9	5.2
Automobile workers	28 729	92	66	18	17.8	12.8	3.5
Science workers	11 366	36	16	13	17.6	7.8	6.3
Engineering workers	29 582	76	41	24	14.3	7.7	4.5
Trades persons & labourers	226 152	560	231	229	13.8	5.7	5.6
Photographic workers	2897	7	2	5	13.4	3.8	9.6
Food handlers	106 396	219	121	40	11.4	6.3	2.1
Veterinary workers	2488	5	3	0	11.2	6.7	0
Process workers & packers	66 031	97	48	34	8.2	4.0	2.9
Cleaners	44 713	49	27	15	6.1	3.4	1.9
Production managers & inspectors	30 535	23	3	14	4.2	0.5	2.5
Farmers	83 177	53	16	28	3.5	1.1	1.9
Childcare workers	17 528	4	1	2	1.3	0.3	0.6
Transport workers	57 453	13	4	8	1.3	0.4	0.8
Emergency workers-other	14 669	3	3	1	1.1	1.1	0.4
Cash handlers	227 822	28	10	8	0.7	0.2	0.2
Teachers	103 539	11	6	5	0.6	0.3	0.3
Clerical & managerial workers	565 190	23	11	12	0.2	0.1	1.2
Social welfare workers	18 963	0	0	0	0	0	0
Miscellaneous / Others	149 181	37	15	16	1.4	0.6	0.6
Missing	-	30	15	26	-	-	-

Rates of occupational skin disease

Table 8 presents the occupations with the highest relative rates of OSD referred to our clinic. This is contributed to by ICD and ACD but also other causes such as contact urticaria and latex allergy. People in the hair and beauty professions had the highest relative rate of OSD, with nearly 70 cases per 100 000 workers each year, followed by machine and plant operators and automobile workers. These are not true incidence rates. However, since the Occupational Dermatology Clinic is the only specialised occupational dermatology clinic in Victoria, we believe that approximately 80% of workers with moderate to severe suspected occupational dermatitis are referred to our clinic for assessment. Despite this, we have no way of knowing how many cases we are missing. The 'missing' group includes workers who do not attend a general practitioner, especially those with mild disease; those who are not referred by their general practitioner to a dermatologist; those who are not referred by their dermatologist for patch testing, or finally those who have patch testing elsewhere. There is no reason however to believe that there is any difference in referral patterns between any occupational groups, so we believe that these figures do give an accurate indication of the relative rates of OSD between occupational groups.

Discussion

The relative rates of OSD in the occupations of our referred Victorian population have been calculated and presented in this report. These figures are substantially lower than those reported by Dickel[5, 41] however, in Germany all suspected OSD must be reported. No such reporting scheme exists in Australia and our figures are likely therefore substantially to underestimate the true occurrence of OSD.

Nevertheless, we believe that the relative rates of OSD in this population are particularly informative. Hair and beauty workers are the occupation most at risk of OSD. They are followed by machine and plant operators, healthcare workers and automobile workers. Food handlers and trades persons drop down the list as a result of the large number of workers in these groups. These groups are similar to those reported by McDonald et al. from the UK[42]. It is also interesting to note that the majority of occupational groups have a higher incidence of ICD than ACD. The exceptions to this observation are hair and beauty workers, photographic workers and machine and plant operators, where there is increased possibility of exposure to allergens.

More than half (56%) of the patients diagnosed with substantially or partially work-related skin disease at our Occupational Dermatology Clinic were male. This is a higher figure than reported by Kucenic[43] or Dickel[5] but less than reported by Goon[44] from Singapore. In another smaller German study by Dickel's group, they also found a preponderance of female workers (58%)[41]. In contrast, males account for approximately 75% of cases of OSD in Singapore[44], possibly because the workforce is dominated by males, particularly in industries such as engineering, building/construction and electrical. In addition, trades such as hairdressing are not included in their statistics[44].

A primary diagnosis of ICD was made in 44% of cases of OSD. However, overall ICD was part of the diagnostic scenario in 71% of cases. The relative rate of ICD is comparable to that reported by Dickel et al. (74.9%)[41], but higher than previously reported elsewhere[35]. In a retrospective analysis of five years of data, Kucenic and Belsito identified 135 patients who had been diagnosed with an OSD. They found that ICD affected only 34% while ACD affected 60%[43]. The ratio of ICD to ACD is very dependent on the population referred for testing. In addition, we have noted reluctance among some dermatologists to make a diagnosis of ICD, as there is no diagnostic test that can be performed and it is largely a subjective diagnosis after the exclusion of ACD with patch testing. That 70% of patients with OSD have some degree of ICD is perhaps surprising, but is likely to reflect our policy of identifying all the factors contributing to a patient's disease. The differences in causes of ICD between the sexes are explained by their differing occupations. Females comprise the majority of hairdressers and nurses, where wet work and frequent exposure to detergents and shampoos are daily hazards. Males comprise the majority of mechanics and engineers, where exposure to solvents

and cutting oils is common. Overall, the majority of cases of ICD occurred in males, representing the overall predominance of males in manual jobs. The overall causes are generally similar to those reported by Goon[44] and Dickel[41], although 'wet work' was the most common irritant in Dickel's study.

While a diagnosis of ACD was made in 1135 cases of OSD it was the primary diagnosis in only 712 (32.7%). Although many workers may have allergic reactions on patch testing, these are not always relevant to their work, and in this study, ACD was only diagnosed as the primary diagnosis when there was evidence of a relevant occupational exposure to explain their presentation.

Relatively few research groups have reported more than one diagnosis contributing to workers' clinical presentations, which we feel is an important oversight in the literature[5, 43, 45]. An exception is Rietchel et al[45] who reported frequencies for both primary and secondary diagnoses. They found that ACD was more common than ICD as a primary diagnosis, but less common as a secondary diagnosis. However, overall they had a secondary diagnosis in only 29.6% of patients, and no tertiary or quaternary diagnoses. We have assigned a secondary diagnosis to 57.6% of patients with OSD, and a tertiary diagnosis to 17.6% of patients. Dickel et al. also presented data on patients in whom multiple diagnoses had been made, though they have not presented specific data on the priority of the diagnoses[41].

The most common occupationally relevant allergens amongst patients at our clinic were tetraethylthiuram disulfide, followed by ammonium persulfate, thiuram mix, tetramethylthiuram monosulfide, potassium dichromate, 4-phenylenediamine, tetramethylthiuram disulfide and epoxy resin. These are different to those reported by Kucenic[43]. They found nickel to be the most common allergen in OSD. While we found nickel to be the most common positive reaction on testing, we usually did not find any relevant exposure in the workplace and it is ranked fourteenth in our data. They also had high rates of allergy to the topical antibiotics neomycin sulfate and bacitracin. These are not commonly used in Australia and hence were not identified in this study. Finally they do not list 4-phenylene diamine (permanent hair dye), ammonium persulphate (hairdressing bleach) or glyceryl monothioglycolate (perming solution). This appears to be because they did not assess many hairdressers, whereas in our referred population, hairdressers and beauty therapists are the fourth most common occupational group and the occupation with the highest rate of OCD. Hairdressers have also been shown to have the highest incidence rates of OSD elsewhere[5, 42].

Our list of common allergens (Table 4) is most similar to that of Dickel[41]. However, one difference is that they include natural rubber latex in this group, it being their most common allergen, followed by potassium dichromate and ammonium persulphate. As would be expected, the most common allergens found in Rosen's study in New South Wales were similar to ours: potassium dichromate, thiurams and epoxy resins[46].

Our data shows that the occupations in which OSD is most commonly diagnosed are tradespersons and labourers, healthcare workers, food handlers, hairdressers and beauty technicians and machine and plant operators. This is broadly similar to the occupations previously reported[5, 43-45], with the exception of the Singaporean data[44], and that from Kucenic[43], for the reasons previously discussed. The common presentation of OSD on the hands, arms and face is to be expected. Not only are these exposed areas, but work is invariably done with the hands, and they are therefore most frequently affected. In some studies, the proportion of patients with hand dermatitis referred for assessment to an occupational clinic can be as high as 86%[5].

Nearly 50% of patients diagnosed with OSD in this clinic were considered by the consulting dermatologist (RN) to have an atopic tendency. Dickel et al. have previously reported that 21.6% of OSD cases within certain occupational groups may be ascribed to an atopic skin diathesis; that is a personal history of atopic dermatitis[47]. Rosen and Freeman also showed that workers with an atopic diathesis were more at risk of ICD than ACD[46]. Definitions of atopy inevitably vary between studies making comparisons difficult, but atopy is clearly very common in this population of workers although it was not found to be more associated with ICD than ACD.

Patients with PPOD and psoriasis were found to be slightly older. The diagnosis of PPOD may only be made if the dermatitis is shown to persist after all relevant exposures have been eliminated, and adequate treatment has been instituted. It is a diagnosis more commonly made on patient follow-up than on initial assessment. Psoriasis occurs in all ages but it was interesting that patients with psoriasis were generally older. A lower age was seen for patients with contact urticaria. This is likely to be because the majority of patients in this group are food handlers, who are allergic to foodstuffs, and who generally tend to be younger.

While this study has not provided data regarding successful workers' compensation claims, our previous work suggests that far fewer workers in Australia lodge successful claims for OSD than who have OSD[12]. Anecdotally, our experience is that workers with OSD are often reluctant to submit claims for their skin disease. In addition, we have also found that females are less likely to claim workers' compensation (unpublished data), and note that the hairdressing trade is predominantly comprised of females. It would be very worthwhile to compare relative rates of OSD from clinic data with workers' compensation statistics.

The main limitation to this study is that the data are sourced from only one tertiary referral clinic in Melbourne. Nevertheless as mentioned, this clinic captures a large proportion of cases of moderate to severe occupational dermatitis in the state of Victoria. Furthermore, our data are inherently biased towards more severe cases of OSD due to Australia's referral-based medical system where only the more severe cases of OSD are likely to be referred for patch testing. However, the specialist nature of the clinic means that each patient undergoes extensive investigations, including patch testing and often prick testing, and therefore detailed information is obtained. With the majority (>95%) of patients in this study having been assessed by one physician (RN), there has been consistency with regard to the process of diagnostic decision making and the determination of atopy. This is the largest study of occupational dermatitis to date from the southern hemisphere. Notwithstanding there are the limitations from using a database not designed solely for research, including the misclassification of information and non-entry into the database.

In summary, we confirm the importance of OCD as the most common cause of OSD, with more ICD than ACD in our data in a referred clinic population. ACD was diagnosed only where relevant work related exposures were documented. We provide further evidence on the common causes of ICD and explain the differences observed between male and female workers. The importance of considering multiple contributing factors to a clinical presentation is emphasised. There was a high rate of atopy in patients diagnosed with OSD, although this was not significantly different in those with ICD. Finally, relative rates of OSD in certain industries and occupations were estimated.

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