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REVIEW

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The importance of occupational skin diseases in the United States

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Abstract Occupational skin diseases and disorders (OSDs) are the most commonly reported non-trauma-related (acute or cumulative) category of occupational illnesses in the United States. This factor, along with their potential chronicity, their effect on an individual's vocational and avocational activities, and the fact that they are preventable, point out the public health importance of OSDs. It can be difficult to obtain accurate epidemiological data for OSDs in the US, and all sources have their limitations. OSD cases that result in days away from work are important categories to study, since days away from work may be used as an indicator of the severity of a case. Descriptive epidemiology may be used to provide further information on these "more severe" cases, to determine, for example, high-risk industries, occupations, and exposures, and then to use this information to target the high-risk, "more severe" cases for prevention strategies. The goal of the US Public Health Service for the year 2010, as established in its "Healthy People 2010: National Health Promotion and Disease Prevention Objectives", is to reduce national OSDs to an incidence of no more than 46 per 100,000 full-time workers. Both irritant and allergic contact dermatitis are considered to be priority research areas as outlined in the National Occupational Research Agenda introduced in 1996 by the National Institute for Occupational Safety and Health. Increased knowledge and awareness of occupational skin diseases will assist in the achievement of the national public health goals.

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Epidemiological data and limitations

Epidemiological data related to occupational skin diseases (OSDs) in the US come from a variety of sources. It can be difficult for one to obtain accurate epidemiological data for OSDs in the US, and all sources have their limitations. First of all, though a case definition is a prerequisite for the gathering of epidemiological data, there is no standard case definition for OSDs. The case definition can vary from one data source to another and may be based on employer reporting, employee self-reporting, skin patch test results, workers' compensation claims, or clinical diagnosis.

The accuracy of the diagnosis is related to the skill level, experience, and knowledge of the medical professional that makes the diagnosis and confirms the relationship with a workplace exposure. Guidelines are available for the assessment of the work-relatedness of skin diseases, but even with guidelines the diagnosis may be difficult. The lack of a standard case definition and the difficulty of diagnosis lead to potential misclassification of OSDs, resulting in overestimation or underestimation of disease frequency.

There are other problems in the assessment of the epidemiology of OSDs:

1. Except in states where all occupational diseases are reportable, OSDs are not reportable diseases, making health department data sources unavailable for disease monitoring.
2. OSDs are not diseases that commonly lead to mortality or hospitalization; thus, death certificates or hospital records are not potential data sources.
3. OSDs are diseases seen and treated (though not always specifically diagnosed) by medical professionals in multiple specialties, making review of physician-based data sources inefficient.

4. OSDs are diseases that often go untreated and undiagnosed; thus, many cases may never be documented in any data source.
5. Once a diagnosis of an OSD is made, a case does not necessarily elicit a public health response.
6. Individuals with OSDs who seek medical care may be a unique subset of the population. Through this self-selection bias, the information obtained may not reflect the epidemiology of the disease in the general working population.
7. Unique exposures may occur in different populations and different industries, making the epidemiology of the disease in one population not necessarily generalizable to other populations.
8. Exposures change with time, and the affected worker may continue to have disease yet no longer be exposed to the causative agent. The evaluation of past exposures may be exceedingly difficult, often relying on historical records, job descriptions, or employee recollection. The latter is subject to recall and information bias.
9. Cross-sectional studies of workers, a common epidemiological study design, are subject to survivor bias. Those with severe skin disease leave the workforce, leaving only those who are less affected or not susceptible to disease to be included in the studies.
10. As in epidemiological studies of other diseases, the epidemiological terms used in the published literature on OSDs are sometimes used incorrectly (e.g., the term ''incidence'' is all too often used to describe prevalence).

Despite the limitations, the epidemiology of OSDs is important. OSDs are preventable diseases and only through the knowledge of their distribution and determinants will the goal of prevention be achieved.

Public health importance

Measures of the public health importance of a disease include the absolute number of cases, the incidence and prevalence, the economic impact of the disease, and the prognosis and preventability of the disease [8, 9].

Specific US national occupational disease and illness data are available from the US Bureau of Labor Statistics (BLS). The BLS conducts annual surveys of employers selected to represent all private industries in the US. The survey excludes approximately 23% of employed persons, including the self-employed, farms with fewer than 11 employees, private households, and government agencies [4]. It depends on compliance and reporting by the employer and employee, and the recognition and diagnosis of an occupational injury or illness. The 1997 survey sample was composed of approximately 164,000 employers [3]. A general category of ''occupational skin diseases or disorders'' is tabulated in this survey. BLS survey examples of OSDs include contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; chrome ulcers; chemical burns or inflammations [3]. BLS data show that OSDs accounted for a consistent 30–45% of all cases of occupational illnesses from the 1970s through the mid-1980s but recently accounted for 10–15% of all occupational illness [3]. A decline in this proportion may be partially related to an increase seen in disorders associated with repeated trauma (primarily musculo-skeletal disorders).

BLS data for OSDs for 1993 to 1997 are shown in Fig. 1. For 1997, BLS data estimated 57,900 cases of OSDs in the US workforce [3]. However, it has been estimated that the number of actual OSDs may be on the order of 10 to 50-times higher than that reported by the BLS [10, 15]. This would potentially raise the number of OSD cases to between 500,000 and 2.9 million per year. BLS data showed an annual incidence rate of 67 cases per 100,000 workers in 1997 [3]. Total numbers and incidence rates of OSDs by major industry division from the BLS Survey for 1997 are listed in Table 1. The greatest number of cases of OSDs is seen in manufacturing, but the highest incidence rate is seen in agriculture/forestry/fishing.

In 1988, the National Health Interview Survey (NHIS) included an Occupational Health Supplement.

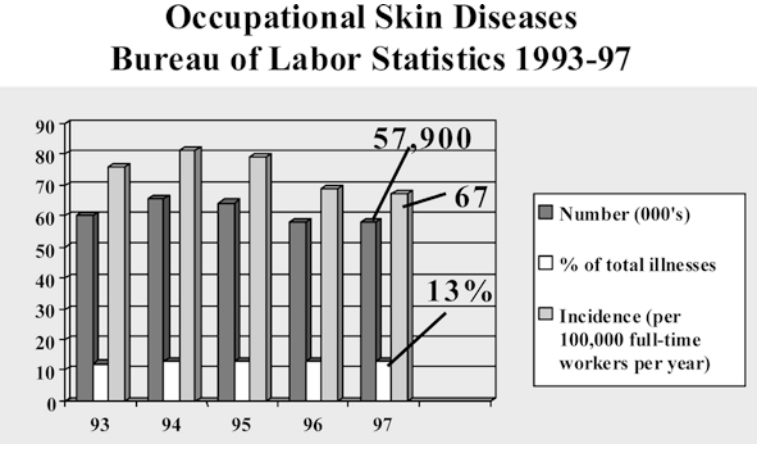

Fig. 1 Occupational skin diseases. Bureau of Labor Statistics 1993–1997

Table 1 Numbers and incidence of occupational skin diseases by major industry, 1997

Industry	Number of cases	Incidence (per 100,000)
Agriculture/forestry/fishing	3,000	226
Manufacturing	26,000	139
Services	15,600	61
Transport/utilities	3,200	52
Mining	300	51
Construction	1,800	35
Wholesale/retail	7,600	34
Finance/insurance/realty	500	7
Total	57,900	67

The survey consisted of personal interviews of randomly selected household. For 30,074 people who participated in the NHIS, the period prevalence for occupational contact dermatitis (the most common OSD) in the preceding year was 1.7% [1]. The projection of these results to the US working population resulted in an estimate of 1.87 million people with occupational contact dermatitis [1] It is important for one to stress that the numbers and rates in the BLS and NHIS surveys are not directly comparable, because they rely on different information sources with different ascertainment methods and different case definitions.

The economic impact of a disease can be measured by the direct costs of medical care and workers' compensation or disability payments, and the indirect costs associated with lost workdays and loss of productivity. An analysis of 1984 US OSD data estimated medical costs of over $4.7 million ($67 per case) and workers' compensation claim awards of over $6.3 million ($1,590 per case) [10]. The estimated indirect cost of lost productivity due to OSDs in 1984 was $11 million ($700 per case) [10]. In 1984 the estimated direct and indirect costs exceeded $22 million. However, if one considers that the actual annual incidence may be 10 to 50-times greater than the BLS estimate, the total annual cost of OSDs may range from $222 million to $1 billion [10]. These estimates do not include costs of occupational retraining or costs attributable to effects on the quality of life.

A more recent review of 7,445 workers' compensation claims for OSDs over a 5-year period in the state of Washington looked at both medical bills and time-loss payments [7]. The total medical bills, including pharmacy bills, for the 5-year period were $1.22 million (median $97 per claim), and time-loss payments were $1.23 million (average of $1,881 per time lost claim) [7].

Over the years there have been changes in the epidemiology of OSDs, the overwhelming majority of which is contact dermatitis. A decrease in the absolute number of cases (and incidence) in the BLS survey from the 1970s and into the 1990s may be attributable to several factors: changes in industry and industrial practices, increased awareness and preventive measures, and possible under-reporting, under-recognition, and misclassification [21]. Still, the data do point out that OSDs are relatively common. They are the most commonly reported non-trauma-related (acute or cumulative) category of occupational illnesses. This factor, along with the potential chronicity of OSDs, their effect on an individual's vocational and avocational activities, and the fact that they are preventable, point out the public health importance of OSDs.

Cases resulting in days away from work

OSDs that result in days away from work are important categories to study, since days away from work may be used as an indicator of the severity of a case. It needs to be emphasized that there are limitations in the use of days away from work as a proxy for severity. Days away from work may be an indicator of the severity of a case but may also reflect other factors, such as institutional and administrative factors (e.g., acceptance of time off by an employer, eligibility for time off for a worker); the correct diagnosis and recording of the disease as an occupational illness; variability in specific recommendations from a healthcare provider regarding time off; flexibility/variability of the job (enabling the worker to avoid the offending exposure without an actual job restriction or reassignment); personal factors (i.e., personal reaction to illness). In addition, not all workers are covered by the data sources that traditionally tabulate those who lose time from work as a result of occupational illness or injury; i.e., ineligibility for workers' compensation or exclusion from the BLS survey may result in no information being available for some severe cases. Finally, different reporting sources have different scopes of coverage, different definitions for occupational illnesses and injuries, and different methods for tabulating days away from work, resulting in potential inaccuracies and difficulties in comparing data from varied sources [19].

Data for cases resulting in days away from work are available from sources at the state and national levels. Note well, that some of the studies or data sources noted below use averages (means) to report days away from work, while others report medians. Since lost workdays are not normally distributed among the lost workday cases, means can obviously be skewed by a small number of high-end outliers.

State data

Prior to the Occupational Safety and Health Act of 1970, statistical data for OSDs were available only from some states through state-based workers' compensation boards, or labor or health departments [21]. Using workers' compensation data one may calculate the number of claims per number of eligible workers or the "claims rate". Under the assumption that claims filed are new cases for the period under study, the claims rate could be considered an incidence rate [13]. Selection bias

prohibits these data from being generalizable to the US working population, because not all workers are covered by workers' compensation and not all workers seek compensation for work-related illnesses. A study in Michigan showed that only 9–45% of workers that had been reported to the state as occupational disease cases by employers, hospitals, clinics, and physicians, ultimately filed for workers' compensation benefits [2]. Among the conditions least likely to generate a claim were skin problems (odds ratio of 0.26; 95% confidence interval: 0.19–0.36) [2]. In addition, data from different states are not comparable, since workers' compensation systems, worker eligibility, and case definitions for compensable illnesses, vary. It is also important for one to stress that the numbers and rates in the BLS survey, NHIS survey, and workers' compensation data, are not directly comparable, because they rely on different information sources and case definitions.

The Sentinel Event Notification Systems for Occupational Risk (SENSOR) is a program involving cooperative agreements between the National Institute for Occupational Safety and Health and state health departments. This program initially included three state-based surveillance systems for occupational dermatitis, in Ohio, Oregon, and Washington. As part of "SENSOR Dermatitis" each state reviewed workers' compensation records.

From 1986 to 1992 there were 6,322 disability claims for skin disease filed in Ohio (18 claims per 100,000 workers) [18]. In Ohio in 1992, each claimant for workers' compensation for an OSD missed an average of 10.9 workdays due to the skin disorder [18]. The major causes of OSDs in Ohio included chemicals, coal/oil, soaps, and plants.

The Oregon Health Division reviewed Oregon workers' compensation data from 1988 to 1992. Claims requesting only medical expenses are not recorded and were not included in the review. This review showed that there were 2,464 claims for lost work time due to dermatitis, but information on time lost from work was available for only the 879 accepted claims [20]. For these, the average days away from work was 35, with a range from 1 day to more than 3 years. For these 879 accepted claims with time off from work, 560 (63.7%) were awarded temporary total disability, 134 (15.3%) permanent partial disability, and one worker was awarded permanent total disability. Of the accepted claims, over 57% were for dermatitis that affected the hands or arms. Sources of the dermatitis included chemicals (44%), plant materials (14%), unknown materials (13%), food products (8%), biological agents (7%), and clothing/textiles (6%). Of all accepted workers' compensation claims for dermatitis in Oregon, the most common occupations were: laborers (14.2%), food service (13.8%), machine operators (13.1%), agriculture (9.0%), health professionals (8.2%), and janitors/maids (6.4%), followed by production crafts, mechanics, construction and hairdressers/cosmetologists. The sources of the dermatitis for specific occupations showed that amongst laborers and machine operators the sources were quite varied. Soaps and cleaners were important sources of dermatitis for food service workers (47%) and health professionals (25%) and plants were important sources for agricultural occupations (63%). Hairdressers and cosmetologists had the highest proportion of permanently disabling claims.

A similar review was conducted as part of the SENSOR Dermatitis project in the state of Washington. From 1989 to 1993, there were 7,445 claims for OSDs, and 90% of the claims were for dermatitis [7]. Of the 7,445 claims, 5,695 were accepted; 5,020 (88%) were for medical benefits only, while 652 (11%) were also lost work-time claims. These claims accounted for 38,623 days of lost time, with an average of 59 days and a median of 11 days. For all accepted claims, the highest rates were seen in the general categories of agriculture/forestry/fishing (280 per 100,000 full-time equivalent employee-years), manufacturing (180), and construction (130). More specific higher-rate industries included aircraft and parts manufacturing (500 per 100,000), miscellaneous plastics-product manufacturing (480), beauty shops (460), fruit and tree-nut processing (370), miscellaneous food and kindred product manufacturing (320), and painting contractors (290). Most of the accepted claims (57%) were due to chemical exposures, most commonly soaps/detergents (12.2%) and solvents/degreasers (3.4%), followed by vegetation (9.6%) and apparel/gloves (4%).

US national data

A review of the BLS Annual Survey data from 1972 to 1976 showed an annual range of 71,600 to 89,400 OSD cases (130 to 170 per 100,000 workers) [22]. Of these, the number of lost workday cases ranged from 17,300 to 20,500 (30 to 40 per 100,000). In 1972 to 1976, 22–25% of the workers with OSDs lost time from work [22]. Among these, the average workdays lost ranged from 10 to 12 days.

The BLS Annual Survey was revised in 1992 to obtain further information on illnesses and injuries that result in lost work-time [5]. In 1997, BLS data show that of 57,900 cases of OSDs in the US, 8,261 (14.3%) resulted in days away from work [3]. Of these, 6,589 (80%) were due to dermatitis. Days-away-from-work case counts and rates due to disorders of the skin and subcutaneous tissue by major industry are shown in Table 2. For the 8,261 cases of disorders of the skin and subcutaneous tissue with days away from work, the median days away from work was 3; the complete distribution of days away from work is shown in Fig. 2. A similar distribution was seen for the dermatitis cases, and the median number of days away from work for dermatitis cases was also 3.

A more thorough review, which looked specifically at cases with days away from work, used 1993 BLS data [4]. This review showed that of 60,200 cases of OSDs (76

Table 2 Days-away-from-work case counts and rates due to disorders of the skin and subcutaneous tissue by major industry, 1997

Industry	Number of cases	Incidence (per 100,000)
Agriculture/forestry/fishing	732	54
Manufacturing	2,651	14
Services	2,292	9
Transport/utilities	509	8
Mining	15	2
Construction	773	15
Wholesale/retail	1,155	9
Finance/insurance/realty	133	2
Total	8,261	10

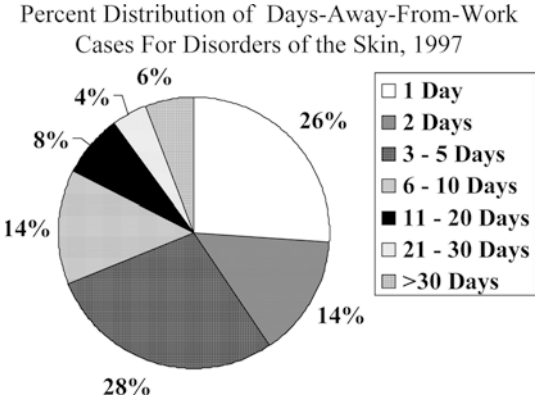

Fig. 2 Percent distribution of days-away-from-work cases for disorders of the skin, 1997

per 100,000 workers), 12,613 (21%;16 per 100,000 workers) resulted in days away from work. Of those with days away from work, 70% had a diagnosis of dermatitis. For the dermatitis cases, 58% were male, 56% were between 14 and 34 years of age, and 36% had worked for their employer for less than 1 year. The overall rate for days-away-from-work dermatitis cases was 11.2 per 100,000 workers. The highest rates for dermatitis resulting in days away from work were seen in the leather and leather-products industry (77 per 100,000 workers), agricultural crop production (57), amusement and recreation services (43), hotels and other lodging places (26), rubber and miscellaneous plastics products (25), and food and kindred products (23) [4]. The median days away from work due to occupational dermatitis was 3, but 17.4% of lost workday cases had over 11 days away from work. Industries with days away from work that were above the median included the paper and allied products industry (8 days), social services (6), and the stone, clay, glass, and concrete manufacturing industry (6). In terms of specific occupations, the most cases were seen in non-construction laborers (541 cases), followed by miscellaneous food preparation occupations (473), nursing aides/orderlies/attendants (445), and grounds keepers and gardeners (442). Cooks had a median of 9 days away from work, followed by licensed practical nurses with 6 days. The most commonly reported sources included cleaning and polishing agents and disinfectants (14.7%), poison ivy/oak/sumac (13.9%), unspecified chemicals and chemical products (13.5%), and clothing/shoes (9.2%). The highest medians for days away from work were seen with exposures to calcium hydroxide or calcium oxides (9 days), dyes/inks/photographic and copying solutions (7), and solvents and degreasers (5).

Prevention

Strategies in the prevention of occupational contact dermatitis include: identification of allergens and irritants, substitution of chemicals that are less irritating or allergenic, establishment of engineering controls to reduce exposure, utilization of personal protective equipment such as gloves and special clothing, the emphasizing of personal and occupational hygiene, and, establishment of educational programs to increase awareness in the workplace [11, 12, 16].

Over half a century ago J.G. Downing, a Boston dermatologist, noted some of the problems in studying the epidemiology of OSDs: "Dermatologists have always been cognizant of the deleterious effect of occupational exposure on the skin...To determine accurately the incidence of cutaneous disease in industry is an impossible task, owing to the extremely variable interpretations of statistics and the lack of adequate terminology" [6]. There have been some improvements in the epidemiological study of OSDs, but the data remain far from perfect. Downing also emphasized the important role of investigations when one is working toward the prevention of OSDs: "...prevention and early detection are much cheaper than indifference and neglect ...every outbreak should be thoroughly investigated, for the hypersensitive person may constitute the warning signal of a whole series of reactions, and careful study of his condition may be the means of preventing similar eruptions" [6].

Thorough investigations of workers with OSDs can be difficult. In any investigation important roles can be undertaken by employers, employees, healthcare providers, industrial hygienists, and health authorities. Workers should be encouraged to report all potential work-related skin problems. These should be investigated on an individual basis by the company or consulting healthcare providers. Because the work-relatedness of skin diseases may be difficult to prove, each person with possible work-related skin problems needs to be fully assessed by a physician, preferably one familiar with occupational/dermatological conditions. A complete assessment would include a full medical and occupational history, a medical examination, a review of exposures, possibly diagnostic tests (such as skin patch tests to detect causes of allergic contact dermatitis), and complete follow-up to note the progress of the affected worker. Individuals with definite or possible occupational skin diseases should be protected from exposures

to presumed causes or exacerbators of the disease. In some cases of allergic contact dermatitis, workers may have to be re-assigned to areas where exposure is minimized or non-existent. However, the lack of availability of allergens for skin patch tests in the US (especially those relevant to occupational exposures) limit the accuracy of diagnosis and limit one's ability to define etiologies of allergic contact dermatitis. This is a major impediment to the prevention of OSDs.

Conclusion

Three factors point out the public health importance of occupational skin diseases: (1) occupational skin diseases are common; (2) they often have a poor prognosis; (3) they result in a noteworthy economic impact on society and the stricken individual, as they affect vocational and avocational activities. They are also diseases that are amenable to public health interventions. The goal of the US Public Health Service for the year 2010, as established in its "Healthy People 2010: National Health Promotion and Disease Prevention Objectives", is to reduce national occupational skin disorders or diseases to an incidence of no more than 46 per 100,000 full-time workers [14]. Both allergic and irritant contact dermatitis are considered to be priority research areas as outlined in the National Occupational Research Agenda introduced in 1996 by the National Institute for Occupational Safety and Health [17]. Increased knowledge and awareness of occupational skin diseases will assist in the achievement of the national public health goals.

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