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Proportion of Dermatitis Attributed to Work Exposures in the Working Population, United States, 2011 Behavioral Risk Factor Surveillance System

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Abstract

Background—The US employer-based surveillance system for work-related health conditions underestimates the prevalence of work-related dermatitis.

Objective—The authors sought to utilize information from workers to improve the accuracy of prevalence estimates for work-related dermatitis.

Methods—Three state health departments included questions in the 2011 Behavioral Risk Factor Surveillance System survey designed to ascertain the prevalence of dermatitis in the working population, as well as healthcare experiences, personal perceptions of work-relatedness, and job changes associated with dermatitis.

Results—The percentage of working respondents who reported receiving a clinician's opinion that their dermatitis was work-related was between 3.8% and 10.2%. When patients' perceptions

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicting or competing interests to report in the execution of this study or the publication of the results herein.

were considered, the work-related dermatitis prevalence estimate increased to between 12.9% and 17.6%.

Conclusions—Including patients' perceptions of work-relatedness produced a larger prevalence estimate for work-related dermatitis than the previously published estimate of 5.6%, which included only those cases of dermatitis attributed to work by healthcare professionals.

Keywords

Dermatitis prevalence; occupational; self-report; physician-diagnosed; epidemiology; survey; public health; Connecticut; Kentucky; Michigan

INTRODUCTION

Work-related dermatitis is a term used to describe a broad range of specific skin conditions, including irritant and allergic/contact dermatitis, as well as atopic dermatitis (eczema) that are either caused by, or exacerbated by, work activities or the work environment. Work-related dermatitis affects workers exposed to a variety of different workplace hazards, from metalworking fluids and other chemicals to animal or plant materials that can cause irritant or allergic dermatitis [Marks et al., 2002]. The prevalence of work-related dermatitis in the US working population has been difficult to measure, but like many other work-related illnesses it is widely thought to be significantly underreported due to both individual and systemic factors [Azaroff et al., 2002; Leigh et al., 2004; Lushniak, 2003]. Similarly, studies of dermatitis conducted in European worker populations have produced varying estimates of work-related dermatitis, likely due to similar factors that cause incomplete reporting of occupational illnesses in the United States [Halioua et al., 2012; McNamee et al., 2008; Pal et al., 2009; Stocks et al., 2010; Turner et al., 2007]. This study sought to improve on previously available estimates for work-related dermatitis through inclusion of a set of questions related to dermatitis into a cross-sectional telephone survey of public health risk factors and outcomes performed annually by the Centers for Disease Control and Prevention (CDC) in partnership with state health departments.

The National Institute for Occupational Safety and Health (NIOSH) and the National Center for Health Statistics (NCHS) have estimated that employer-reported statistics compiled annually by the Bureau of Labor Statistics (BLS), which are the basis for annual statistics of work-related disease, underestimated the true burden of work-related dermatitis by approximately 100-fold [Luckhaupt et al., 2013]. Notable differences exist however in how these two separate statistics are derived, in that the BLS statistic is based on incidence data and that the NIOSH/NCHS results relied solely on a prevalence estimate derived from individuals reporting that a doctor or other healthcare professional had told them that their dermatitis was work-related. In addition to the fact that a proportion of dermatitis cases may be mild and transient enough to not warrant a clinical visit, the ability of healthcare professionals to appropriately attribute work-related illnesses to workplace hazards has been shown to be incomplete and highly variable [Azaroff et al., 2002; Lushniak, 2003]. A previous report on work-related asthma showed an increase of between 50–88% of asthma attributed to work if the estimate included individuals who responded affirmatively when they were asked if they thought their condition was work-related [Lutzker et al., 2010]. Lack

of attribution of illness to work by healthcare providers may be even more likely in the case of work-related dermatitis, since contact dermatitis is a common condition in the general population, can be caused by an array of human and environmental factors, and has a wide spectrum of clinical presentations. Preliminary analyses from Michigan researchers, previously published as a letter to the editor in the *American Journal of Industrial Medicine*, showed a 76% increase in dermatitis attributed to work if individuals were asked if they thought their condition was work-related [Rosenman and Fussman, 2012].

MATERIALS AND METHODS

The Behavioral Risk Factor Surveillance System (BRFSS) conducts an annual cross-sectional state-based random digit-dialed land-line and cellular telephone survey of the noninstitutionalized US civilian adult (≥ 18 years of age) population [Centers for Disease Control and Prevention (Overview), 2013]. The survey is designed to collect information on both health conditions in the population as well as the risk factors that may influence them. All states participating in the BRFSS implement a standardized set of core questions. In addition to the core, states also have the ability to include CDC-approved optional modules, as well as state-added questions in the BRFSS questionnaire. The BRFSS is considered one of the most comprehensive population-based public health survey currently conducted annually in the US, is the only one that can provide state-specific data, and is widely accepted as a key component of many public health surveillance systems, including those addressing work-related conditions [Bonauto et al., 2007; Stanbury et al., 2008]. The BRFSS has been determined to be an exempt protocol by the Centers for Disease Control and Prevention and individual state Institutional Review Boards.

As part of the 2011 BRFSS survey, three states (Connecticut, Kentucky, and Michigan) included a set of questions about work-related dermatitis in their state-added survey questions (Table I). Several of these questions were identical to questions asked as part of the 2010 National Health Interview Survey (NHIS) [Luckhaupt et al., 2013]. Kentucky included questions pertaining to dermatitis within their landline BRFSS surveys but did not include these questions within their cell phone surveys. Connecticut and Michigan included dermatitis questions in surveys for both respondent contact types (landline and cell phone), but Michigan asked the dermatitis questions of only 1/3 of their total sample population. All three states submitted their BRFSS survey data to the CDC to be weighted using a process known as raking, or iterative proportional fitting [Pierannunzi et al., 2011]. Connecticut used a combined landline and cell phone raking weight within the analyses of the dermatitis questions, while Kentucky and Michigan used a landline-only raking weight for their analyses due to the fact that the CDC did not provide combined landline and cell phone raking weights for questions that were asked of less than the entire sample population. Connecticut and Kentucky used SAS statistical software (v.9.3) to analyze the BRFSS dermatitis questions from their states, while Michigan utilized SAS-Callable SUDAAN statistical software (v.11.0) for their analyses. Programming and coding were compared for consistency, although each state analyzed its own BRFSS data and provided summary results as weighted prevalence estimates and 95% confidence intervals.

RESULTS

Table II provides an analysis of demographic characteristics for 2011 BRFSS survey respondents who reported both employment and dermatitis within the past 12 months, in addition to comparison data from the 2010 NHIS [Luckhaupt et al., 2013]. In general, demographic characteristics of the study populations were similar among the three states, and also similar to the 2010 NHIS population, with the following exceptions. The overall prevalence estimate of survey respondents with a history of both work in the previous 12-months (working) and a corresponding history of dermatitis, eczema, or any other red, inflamed skin rash (dermatitis) in the same time period was significantly greater in Michigan than the prevalence estimate found in either of the other two participating states and the national estimate from 2010 NHIS. Statistically significant gender differences between working respondents reporting and not reporting a history of dermatitis were seen in both Connecticut and Kentucky, with working female respondents in these states being more likely to report a history of dermatitis than their male counterparts. Data from Michigan identified that working respondents reporting White race were overrepresented in the sample of survey respondents in that state with a history of dermatitis compared to those without a dermatitis history. Conversely, working respondents reporting Black race in Michigan were correspondingly underrepresented in the dermatitis population. The categorical age estimates from the 2011 BRFSS appear to differ slightly from those found in the 2010 NHIS, particularly in the younger age categories, however without corresponding confidence intervals for the 2010 NHIS data, statistical significance cannot be determined.

Table III details the affirmative responses of working survey participants with a history of dermatitis to a set of questions regarding their interactions with healthcare personnel and/or changes in work habits related to their dermatitis, as well as their personal opinion about the work-relatedness of their dermatitis. Again, results of analysis of identical questions asked to participants in the 2010 NHIS [Luckhaupt et al., 2013] are included in this table for comparison.

Approximately three out of every four respondents indicated seeing a doctor or other health professional for their dermatitis during the previous 12 months. Only between 3.8%–10.2% of all respondents reported being told by a doctor or other health professional that their dermatitis was probably work-related. Presumably, this medical opinion was rendered during a clinical visit by the same health professional that respondents reported seeing for their dermatitis, however that information was not specifically requested from respondents. By contrast, between 12.8%–16.8% of respondents in the three participating states indicated that they personally thought their dermatitis was work-related. Combining respondents who indicated that they thought their dermatitis was work-related with those who had received a clinician’s opinion that their dermatitis was work-related gave an overall estimate of the proportion of dermatitis cases that were work-related of between 12.9% –17.6%.

As an indicator of dermatitis severity, respondents were also asked whether they made any changes in their work, including stopping work, changing jobs, or otherwise changing their work activities, in the previous 12 months due to their dermatitis. Although this question was asked in two of the three participating states (CT and MI), the sample size of

Connecticut respondents was too small to allow for a sufficiently robust statistical analysis and is not reported here. In respondents from Michigan, 1.2% of workers with dermatitis reported changing their work activities as a result of their dermatitis.

DISCUSSION

Using a definition of work-related dermatitis that included both clinician-supported opinions and the opinions of individuals themselves, we estimate that between 13–18% of all dermatitis cases were related to work (Table III). This combined estimate was approximately three-times higher than the previous national estimate of 5.6% obtained by NIOSH from the 2010 NHIS data, which included only those cases of dermatitis attributed to work by healthcare professionals [Luckhaupt et al, 2013].

Possible reasons for the notably higher prevalence point estimate obtained when self-reported work-related dermatitis cases were counted include: 1) approximately one out of four individuals with dermatitis reported that they never saw a doctor or other healthcare professional for their dermatitis; 2) the practical constraints of recognizing a case of dermatitis as work-related, including the prevalence of dermatitis in the general population [Furue et al., 2011; Thyssen et al., 2010; Williams et al. 2006], the array of human and environmental factors that can cause dermatitis, and the wide spectrum of clinical presentations; 3) physician uncertainty and concern about the insurance and legal implications of telling a patient that their condition is work related; and 4) incorrect attribution of dermatitis to the work environment by the patient. It is unclear to what extent each of the above factors either individually or collectively affected our prevalence estimates. Although the tendency is to think of incorrect work attribution on the part of the worker as being the likely single overarching factor contributing to the prevalence increase seen here, studies of work-related asthma that were conducted using the same methodology have shown that the prevalence estimates derived from population-based surveys where the patients' perceptions are included are more in line with the American Thoracic Consensus Statements for work-related asthma than those using physician-attributed cases alone [Lutzker et al., 2010] and that the difference between patient and health care provider attribution differs by condition [Stanbury et al., 2008].

Although it is highly regarded as one of the most comprehensive annual survey of health outcomes and risk factors in the US population, the BRFSS does have several limitations in terms of its sampling methodology and analysis [Centers for Disease Control and Prevention (Summary Data Quality Report), 2013]. As with all telephone-based surveys, non-coverage bias is a concern in that not all households have landline telephone service. This is a potential bias against inclusion of low-income households as well as, in more recent years, individuals who use cellular telephones either primarily or exclusively. Non-coverage bias in the BRFSS survey was addressed to some extent by the addition of cell phone respondents in the 2011 survey. Non-response bias may also impact the representativeness of the BRFSS sample, in that the response rates for the 2011 survey were 53% for landline respondents and 28% for cellular telephone respondents [Centers for Disease Control and Prevention (Weighted Response Rates), 2013]. Even with the addition of cellular telephone respondents to some extent in two of the participating states, the sample size for workers

responding affirmatively to each of the questions was generally small, which made identification of statistically significant differences among the states unlikely.

Underlying issues exist with appropriate recognition and self-reporting of medical conditions in any population-based telephone survey without a physical examination or other concrete medical diagnostic information, however it is unclear how prevalent these issues are in worker population studies and whether they tend to overestimate or underestimate the true prevalence of disease [Bolen et al., 2007; Harlow and Linet, 1989; Schenker et al., 2010]. A study of self-reported skin complaints in the general population found a positive predictive value of 82% for individuals self-reporting a skin condition and identification of signs of a skin condition by a clinician [Dalgard et al., 2003]. Similarly, a study of a wide range of skin conditions in North Carolina farmworkers found that several interviews over a period of time produced relatively consistent self-reports of skin disease and risk factors in individual workers [Vallejos et al., 2008]. However, a recent study of self-reports of skin rashes in World Trade Center Health Registry participants found a change in response over time among participants, where 12% recalled having had a World Trade Center exposure-related skin rash at 2–3 years post-9/11, 16% recalled having had a rash at 5–6 years post-9/11, and only 6% consistently reported the condition at both time points [Huang et al., 2012].

The population of workers who did not seek medical care may have had milder cases of dermatitis, which could affect the estimate of the true proportion of dermatitis cases attributable to work. However, it is also reasonable to assume that workers who did not report interaction with a healthcare professional for their dermatitis had differentially poor access to healthcare. Workers in higher-risk occupations, presumably including those at higher risk for the development of dermatitis and other skin conditions, tend to have lower annual incomes, are less likely to receive employer-supplemented medical insurance, and may have poorer access to healthcare resources [US Department of Labor, 2012]. If this is the case, the resulting statistic may in fact be an underestimate of the true proportion of dermatitis cases attributable to work. In addition to these limitations, several other filters that could affect the estimates reported here are known to exist as part of the larger system of recognition and reporting of work-related health conditions in the US [Azaroff et al., 2002]. Insight into the impact of these potential confounders on work-related dermatitis prevalence estimates could be gained from comparison of the US model of healthcare delivery with the European worker-based studies cited earlier. Direct comparisons would likely be difficult, as there are few studies that have evaluated work-related skin conditions over the broad scope of all workers in European countries. Instead, many have been limited to workers in specific industries and/or with specific employment characteristics. Nevertheless, the European workers' experience with healthcare access problems or systematic disease reporting issues may be significantly different from those experienced by US workers, based on the variety of European models in place for workers' compensation and healthcare delivery, including government-based universal healthcare and health records, self-referral for specialty care, and various levels of reliance on inpatient vs. outpatient care [Halioua et al., 2012; McNamee et al., 2008; Pal et al., 2009; Stocks et al., 2010; Turner et al., 2007].

When asked about adjusting work activities due to dermatitis, 1.2% of working respondents in Michigan indicated that they did make some changes in either their activities or the physical location of their work due to signs and symptoms of dermatitis. Although based on a small sample size, this estimate of respondents who report changing job activities is nearly identical to the estimate of 1.25% (std. err.=0.38) obtained in the 2010 NHIS [Luckhaupt SE. Personal communication. September 6, 2013]. In conjunction with the prevalence estimates presented here, this finding affects a considerable number of individuals when the size of the workforce is considered. Using the most conservative estimates presented, we can extrapolate that approximately 1.5 million workers annually in the US suffer from work-related dermatitis and, of those over 17,000 may change jobs, relocate within their workplace, or adjust their work activities due to their work-related dermatitis. Further study is needed to determine the economic impacts of these work adjustments. In addition, because this survey was limited to only three states, two of which are in the lower half of all US states in terms of total population, the prevalence estimates and demographic distributions presented here are not necessarily as stable as they should be for extrapolation to the entire US working population. The inclusion by other states of the questions used in this survey will allow more robust estimates to be determined and to more accurately define the burden of work-related dermatitis, including economic effects, in the US. This prevalence data would be useful to clinicians so as to reassert for them the importance of considering work exposures in the diagnosis and management of dermatitis. Also, these results highlight the importance for clinicians to assess their patients' perceptions in order to assure a complete assessment of dermatitis etiologies. Further work that includes verification of diagnosis through physical examination (as in the National Health and Nutrition Examination Survey), as well as determination of work-relatedness through industrial hygiene consultation, would be useful in determining a standardized set of questions to ask to obtain the most accurate prevalence estimates of work-related health conditions.

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TABLE I

Behavioral Risk Factor Surveillance System (BRFSS) state-added dermatitis questions: Connecticut, Kentucky, Michigan, 2011.

Asked to all survey participants	
1	During the past 12 months, have you had dermatitis, eczema, or any other red, inflamed skin rash? (All states)
Asked to survey participants who are currently employed or were employed at some time in the past 12 months AND answered 'Yes' to question 1*	
2	Have you ever seen a doctor or other health professional for your skin condition? (CT and KY only)
3	Have you been told by a doctor or other health professional that your skin condition was probably work-related? (All states)
4	Do you think your skin condition was probably work-related? (All states)
5	Did you tell a doctor or health professional that your skin condition was work-related? (CT and MI only)
6	During the past 12 months, did you stop working, change jobs, or make a major change in your work activities, such as taking on lighter duties, because of your skin condition? (CT and MI only)

* For each question, answer choices included 'Yes', 'No', 'Don't know/Not sure', 'Refused'.

TABLE II

Prevalence estimates and demographic characteristics of respondents with a history of work and dermatitis, eczema, or other red, inflamed skin rash in a 12-month period, in three states: Connecticut, Kentucky, and Michigan, 2011 BRFSS, with national estimates from 2010 NHIS.

	Connecticut	Kentucky	Michigan	*2010 NHIS*[*]
Overall Prevalence	7.9 (7.0–8.8)	7.8 (6.1–9.4)	15.6 (12.6–19.2)	9.8 (9.2–10.3)
n =	173	291	199	1,662
Gender				
Male	40.7 (34.9–46.5)[a]	39.4 (28.5–50.2)[a]	47.4 (36.2–58.7)	*42%*
Female	59.3 (53.5–65.1)a	60.6 (49.8–71.5)	52.6 (41.3–63.8)	*58%*
Age in years				
18–29	18.1 (12.7–23.4)	17.8 (6.1–29.5)	15.4 (7.1–30.2)	*22%*
30–44	31.7 (26.2–37.2)	42.6 (32.0–53.3)	44.4 (33.5–55.9)	*34%*
45–64	44.8 (39.1–50.4)	34.6 (25.8–43.4)	39.0 (29.4–49.6)	*38%*
65+	5.4 (3.7–7.2)	5.0 (1.5–8.5)	1.2 (0.5–2.5)	*6%*
Race				
White	84.0 (79.6–88.5)	91.3 (85.1–97.5)	93.0 (87.6–96.2)[a]	-
Black	7.8 (4.5–11.2)	5.8 (0.0–11.6)	4.4 (2.3–8.3)[a]	-
Other	8.1 (4.8–11.5)	2.9 (0.4–5.4)	2.6 (0.8–8.1)	-
Ethnicity				
Hispanic/Latino	7.3 (4.4–10.2)	0.7 (0.0–2.1)	4.7 (1.1–17.7)	*12%*
Non-Hispanic/Non-Latino	92.7 (89.8–95.6)	99.3 (97.9–99.8)	95.3 (82.3–98.9)	*88%*

Point estimates (percentages) provided with 95% confidence intervals. Includes individuals indicating both a history of work and dermatitis (dermatitis, eczema, or any other red, inflamed skin rash) within the past 12 months. Estimates are weighted unless otherwise noted.

[*] From Luckhaupt et al. *Am J Ind Med*, 2012. Overall prevalence reported as a weighted statistic by the authors. All other point estimates calculated from unweighted case counts reported in the original publication. Methodology for collection of race information was not comparable.

[a] $p<0.05$ compared to the sample reporting work in the last 12 months and no dermatitis

TABLE III

Healthcare experiences, workplace behaviors, and opinions of work-relatedness of respondents with a history of work and dermatitis, eczema, or other red, inflamed skin rash in a 12-month period, among three states: Connecticut, Kentucky, and Michigan, 2011 BRFSS, with national estimates from 2010 NHIS.

	Connecticut (n=173)	**Kentucky (n=291)**	**Michigan (n=199)**	***2010 NHIS (n=1,662)****
Saw a doctor or other health professional for dermatitis	74.9% (69.7–80.2)	77.7% (69.3–86.2)	‡	*75.9%*
Stopped working, changed jobs, or changed work activities because of dermatitis	†	‡	1.2% (0.4–3.8)	*1.25%*** *(S.E.=0.38)*
Told by doctor or other health professional that dermatitis was probably work-related	10.2% (5.9–14.5)	3.8% (0.0–8.4)	8.0% (3.8–16.1)	*5.6% (4.4–7.1)*
[Personally] think dermatitis was probably work-related	16.8% (11.9–21.7)	12.8% (4.9–20.7)	13.8% (7.7–23.6)	‡
Told by a doctor or health professional, or [personally] thought, that dermatitis was work-related	17.6% (12.7–22.5)	12.9% (5.1–20.7)	14.8% (8.0–23.5)	‡

Point estimates (percentages) of affirmative answers provided with 95% confidence intervals. Includes individuals indicating both a history of work and dermatitis (dermatitis, eczema, or any other red, inflamed skin rash) within the past 12 months. Estimates are weighted unless otherwise noted.

† Insufficient sample for appropriately stable statistical analysis

‡ Question not asked as part of the survey

* From Luckhaupt et al. *Am J Ind Med*, 2012.

** Unpublished data. From Luckhaupt SE. personal communication.