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Occupational Respiratory Health: A Survey of Wisconsin Workers Who Wear Respirators

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ABSTRACT

Context: Little is known about Wisconsin workers who wear respirators and the prevalence of work-related asthma (WRA) in that population. To understand this problem, we questioned workers who wear respirators.

Objectives: The primary objective was to learn more about the health experiences of workers who wear respirators. A secondary objective was to evaluate the utility of the survey in WRA surveillance.

Design: A survey was mailed to an opportunistic sample of workers who received medical evaluation for respirator fit testing.

Participants: Surveys were sent to 1356 workers medically evaluated to wear a respirator; 192 surveys were completed and returned.

Results: The majority of respondents were men who have been medically evaluated for respirator wear an average of 3 times during their career. Every time, most respirator medical evaluations used 3 evaluation tools: questionnaire, physical exam and breathing test. Thirty-two percent of survey respondents had some asthma symptoms while at work in the last 30 days, and half reported discussing these symptoms with a physician. Lifetime prevalence of asthma as determined by this survey was 18%. Lifetime prevalence for WRA among this population was 3% (18% among those with asthma).

Conclusions: This survey was an efficient and effective way to learn more about workers' respirator experiences and to determine the prevalence of asthma in this population. Few differences existed between those with asthma and those without. However, some differences were noted between those with asthma and those with WRA. Data also suggest that the respirator medical evaluation process provides an opportunity for health practitioners to discuss asthma and asthma prevention with workers.

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INTRODUCTION

The United States Department of Labor estimates that 3% of all private sector employees use respirators.[1] Applying this statistic to Wisconsin's workforce provides an estimate that approximately 86,000 Wisconsin workers wear respirators.

This project made use of respirator medical evaluation billing codes to gather information about asthma symptoms at work, the respirator medical e valuation process, use and maintenance of respirators, worksite asthmagen exposures, and the prevalence of asthma and work-related asthma (WRA) in workers who wear respirators.

WRA is a common lung disease in industrialized nations. Two forms of WRA exist: 1 in individuals with asthma who develop *work-exacerbated asthma* after exposure to contaminants at their work place, and *occupational asthma*, which develops in those with no history of asthma after a single high dosage or prolonged sensitization to air contaminants at work.[2] Diagnosis of WRA is made by establishing a connection between asthma symptoms and work by a health practitioner. While the numbers are relatively low, examining WRA causes and medication is important because costs associated with workers' compensation claims and hospitalization are high.

Surveillance of WRA is challenging because employers do not routinely collect information about employee asthma, and health care professionals do not routinely collect employment information. Furthermore, some clinics believe information is sensitive and that releasing it to public health agencies will violate patient privacy. Employers resist sharing information for fear of

Table 1. Work-Related Asthma Questionnaires

OSHA respirator Medical Evaluation Questionnaire. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9783. Accessed May 14, 2010.
Wisconsin Asthma Questionnaire—Union Survey, 2003
New Jersey Department of Health and Senior Services, Occupational Health Services Work-Related Asthma Questionnaire
California Work-Related Asthma Surveillance—SENSOR Questionnaire, August 2006
Massachusetts SENSOR—Patient Questionnaire—Work-Related Asthma (WRA); January 2008
US Department of Labor Bureau of Labor Statistics Survey of Respirator Use and Practices, OMB No. 1220-0171; 2000
Asthma Control Test; GlaxoSmithKline. http://www.asthmacontrol.com. Accessed May 14, 2010.
ThedaCare At Work—Respirator Medical Evaluation Questionnaire
Michigan Occupational Asthma Follow-up Telephone Questionnaire
Institute of Occupational Medicine—UK; Survey of the health of people; 1987

alarming workers or triggering an inquiry by the United States Occupational Safety and Health Administration (OSHA). This project sought to overcome some of these challenges by evaluating the utility of using a survey to establish surveillance of workers who wear respirators, to gain an understanding of those workers, and to determine any differences between those with asthma and those without.

MATERIALS AND METHODS

The Survey

An anonymous mail survey was developed to collect information about worker demographics, respirator usage, respirator fitness evaluation, asthma/WRA diagnosis, and symptoms. The survey was based on surveys found in scientific literature and information needed to answer our research questions. Table 1 includes a list of surveys reviewed to generate survey questions. Final questions and a summary of responses are included in the Appendix (online at www.wisconsinmedicalsociety.org/wmj). Surveys were created, scanned, and evaluated using Cardiff Teleform® software.

The Participants

Recruitment of participants involved a 2-step process. First, project staff approached clinics that medically evaluate workers for respirators through an online survey to Wisconsin Medical Society Occupational Workgroup members in order to obtain names of patients who had been tested. Fifteen clinic representatives responded, 6 agreed to participate, and 3 were undecided. Those indicating willingness to participate or who were undecided were contacted to reaffirm participation. Three representatives agreed to supply patient addresses. To increase the sample size, 2 additional clinics were contacted. Both expressed interest but neither provided mailing lists within the project timeframe. Participating clinics identified patients evaluated between 2004 and 2009 who were aged 15 to 85 years at the time of evaluation.

Based on clinic preference, surveys were either sent to patients by the clinic or address labels were supplied to the Bureau of Environmental and Occupational Health (BEOH.) Included with each survey was a cover letter explaining the project and a return postage-paid envelope. Each batch was marked with a due date 2 weeks after the mailing date. The first batch of surveys was distributed April 24, 2009, and the last batch of surveys was returned July 2, 2009.

A total of 1356 surveys were mailed; 138 were returned as undeliverable (10%); 192 completed surveys were returned for a response rate of 16%. (See Figure 1.)

Statistical Analysis

For analysis, participants were organized into 5 groups: "all respondents," "no asthma," "asthma," and, within asthma, sub-categories of "work-related asthma (WRA)," and "no work-related asthma (NWRA)." The following case definitions were used.

- *Asthma:* A doctor or medical professional has ever told you that you have asthma.
- *Work-related asthma:* Meets the asthma case definition, AND has been told by a medical professional that their asthma was work-related.
- *No work-related asthma:* Meets the asthma case definition, AND answered "No" to the question regarding being diagnosed as work-related.
- *No asthma:* Answered "No" to the question regarding being diagnosed with asthma.

Descriptive statistics were generated for all responses using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). Chi-square analysis was done between assigned groups, and a 95% probability (0.05 *P*-value) was used to determine any statistical significance.

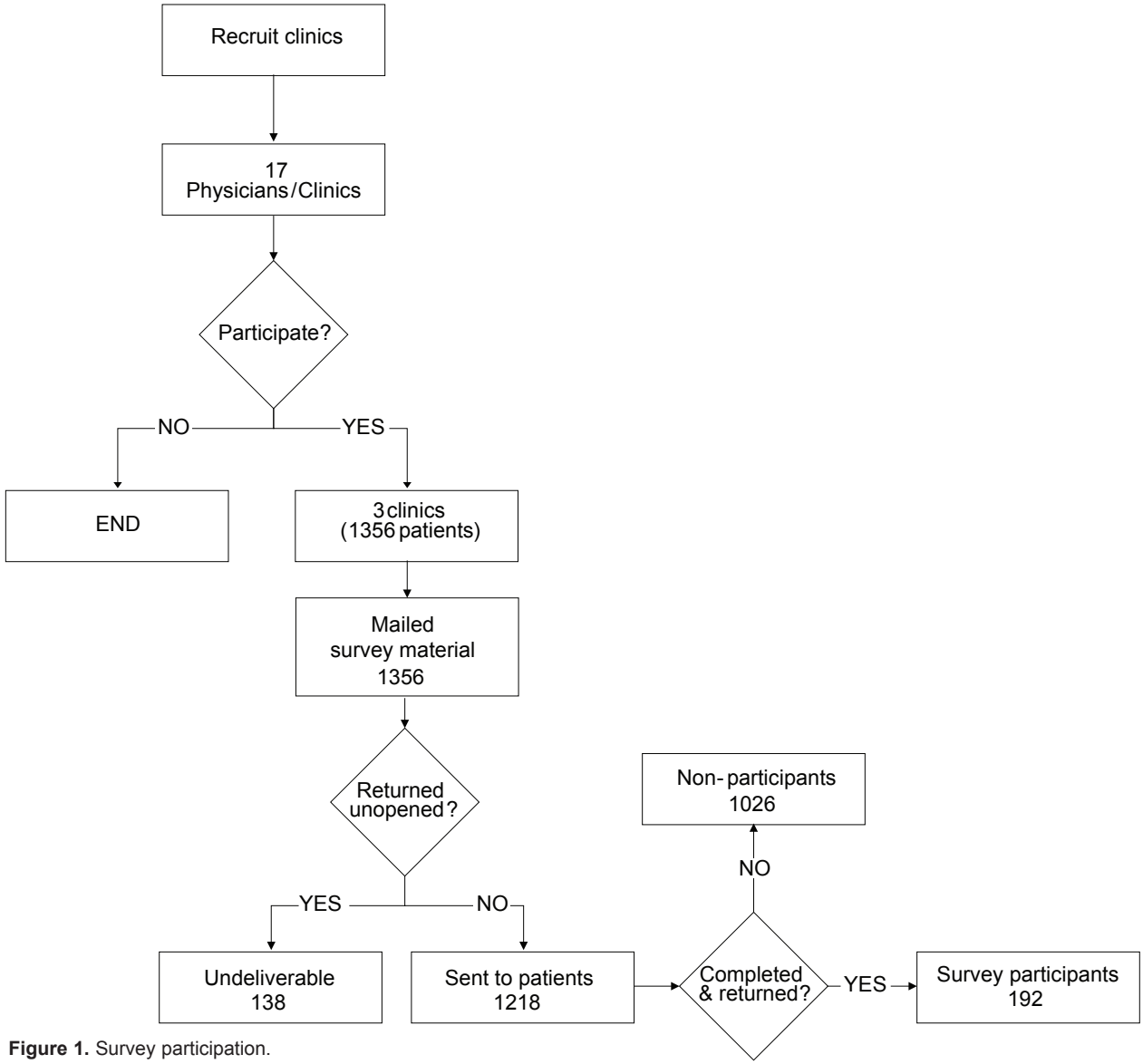

Figure 1. Survey participation.

RESULTS

Demographics

A total of 192 workers participated in the survey. There were 162 (84%) male participants and 30 (16%) female respondents. Nearly all respondents were not-Hispanic white (99%). Two respondents were African American/black (1%). No other races were represented.

Medical Evaluation

All respondents, regardless of their asthma status, reported similar respirator evaluation histories. The number of times they were medically evaluated during work years averaged 4.2 times (range: 0-40 times), and most reported last being evaluated in 2008. Eighty-eight percent of all respondents reported receiving a breathing test. Those diagnosed with WRA reported receiving a breathing test most often during their respirator medical evaluation. Of all respondents, 153 (91%) were approved to be fit with a respirator, including 89% of those who were diagnosed with asthma.

Health

Thirty-four (18%) met the asthma criteria, 155 (81%) responded they did not have asthma, and 3 (1%) did not answer the asthma diagnosis question. A higher percent of female respondents reported having asthma. This pattern is common among adults and may be due to the effect of hormones on esophageal/tracheal physiology.[3] Of respondents with asthma, 6 met our WRA definition (18% of those with asthma; 3% of total participants).

One respondent diagnosed with asthma did not answer the work-related question.

Thirty-two percent of respondents indicated that they experienced asthma symptoms at work not caused by a cold or respiratory infection within the previous 30 days. Twelve percent (23) of all respondents reported experiencing at least 3 asthma-like symptoms at work in the previous 30 days, as did 32% of those with asthma. Comparatively, 5% of respondents reporting no asthma diagnosis reported 3 or more symptoms. Most survey participants experiencing symptoms at work had them less than once a week (60%). Of the 6 respondents without asthma who experienced at least 3 symptoms, 2 reported symptoms 2 or more times a week, 1 reported 1-2 times a week, and 1 < once a week. Two respondents did not report symptom frequencies.

Fifty-six percent of all respondents reported discussing asthma or asthma-like symptoms—wheezing, coughing, chest tightness, and shortness of breath—with their primary care physician, 41% discussed them with an allergist, and 34% discussed them with the physician who did the respirator medical evaluation. In addition to discussing symptoms with their primary care physician, 83% of respondents diagnosed with WRA discussed symptoms with an allergist.

Respondents with asthma were asked how often asthma-specific medication was taken to ease breathing problems on the job. Thirty-nine percent of those with asthma and 67% with WRA indicated that they used inhalers or asthma medicine daily. Fewer indicated the use of inhalers or asthma medicine weekly (12% with asthma and 33% with WRA). Twenty-one percent with asthma (7) indicated that they did not use inhalers or medicine at all, and 1 person with no asthma indicated using breathing medication daily.

Employment

Just under half of the respondents (45%) indicated that they worked in the manufacturing sector the longest. Other frequently cited industry sectors included construction and services (18% each), agriculture (10%), health care (5%), and transportation/warehousing/utilities (2%). Industries were fairly consistent across all asthma groups. Three respondents with WRA (50%) worked in construction the longest. Twenty-one (12.6%) respondents are not currently employed but had been employed in the past.

Ninety-one percent of all respondents reported that they had never changed or quit a job because of asthma-like symptoms while at work. Fifty percent of those with WRA had changed jobs because of asthma-like symptoms. Respondents reporting a job change because of symptoms worked the longest in manufacturing or construction-industry sectors.

Work Activities

Frequent activities for respirator wearers included working directly with paint and chemicals in manufacturing processes or maintenance duties, or grinding and sanding. Those with asthma reported the activities of painting and cleaning. WRA participants' activities included painting or working with chemicals, hazardous materials activities, and grinding or sanding.

Respirator Use

Most participants recalled being trained for respirator fit (96%) and respirator usage (93%). Respirator maintenance training was recalled less frequently (81%). Among those diagnosed with asthma and WRA, the percentage trained in maintenance was lower (67% and 33%, respectively).

Seventy-eight percent of all respondents indicated wearing a canister or cartridge filter mask at work. Fifty-six percent wore a disposable paper mask such as an N-95 type, 32% wore an air-supplied mask, 1 person did not know the type of respirator, and 15 did not respond. Some respondents reported wearing more than 1 type of respirator. Those with no asthma were more likely to wear a canister or air supplied filter mask than those with asthma. All participants with WRA reported wearing an N-95 disposable filter mask at work. Asthma respondents wore respirators an average of 6.8 times (range: 0-31 times) each month, and those reporting no asthma wore theirs an average of 6.6 times (range: 0-31 times). Sixty-one percent of the respondents reported wearing a respirator 0-2 hours at a time. The average continuous amount of time respondents wore a respirator during a work shift was 3-4 hours. Twenty-nine participants (16%) indicated they did not wear a respirator at all. Of those, 6 reported having asthma (26% of those with asthma) and 2 reported having WRA (33%).

Substance Exposure

Sixty-seven percent of the 175 respondents reported being exposed to dust, 60% reported exposure to chemicals, 39% to gases, and 13% to other substances such as biological contaminants. A majority of respondents reported being exposed to multiple contaminants. As with overall respondents, those with asthma or WRA reported a higher exposure to chemicals (57% and 83% respectively).

Many (106) did not respond with specific chemical names. The lack of response should be further investi-

Table 2. Exposures

Acids /bases/oxidizers[a]	Formaldehyde[a]	Polyurethane
Aluminum	Hexavalent chromium[a]	Silica
Ammonia/ ammonium bicarbonate	Hydrocarbons	Solvents
Asbestos	Lacquers	Smoke
Carbon monoxide	Methyl ethyl ketone	Stainless steel fumes[a]
Chlorine[a]	Mold	Sulfuric acid[a]
Concrete dust	Natural Gas	Sulfur oxides
Cyanates/Isocyanates[a]	Nickel[a]	Thinners
Diesel fuel	Paint fumes[b]	VOCs
Epoxy resins[a]	Plexiglass/fiber glass	Welding fumes
Feathers	Lacquers	Wood dusts
Fluorine[a]	Pollen	

[a] Asthmagen
[b] Asthmagen determination is dependent on chemical composition.

gated because all workers are required to have access to material safety data sheets. Of those who did report specific substances, the most frequently reported include lead- or epoxy-based painting products, chlorine, cement/silica/quartz dust, strong acids (e.g. muriatic acid), sulfur dioxide, ammonia, wood dust, and methyl ethyl ketone (MEK). We compared these to known asthmagens and list them in Table 2. (Many researchers/references make the distinction between asthma inducers [cause] and inciters [triggers]. Here we take a broader view and call any substance with the potential to cause airway hypersensitivity regardless of its mechanism an asthmagen.) Those diagnosed with WRA reported working with epoxy resins, paints, lacquers, and polyurethane most often. However, the numbers are small and no associations could be made.

DISCUSSION

Low Response Rate

The 2-step process for this survey project was timely and economical; however, we were concerned with project validity because both clinic participation and patient response was low.

Clinics stated a lack of staff and/or legal concerns about violating patient privacy rules as reasons for not participating. Initial clinic inquiry was used to educate clinics regarding Wisconsin State Statute Chapter 250 and exemption from HIPAA for public health surveillance, investigation, or intervention.[4,5] Clinics choosing to participate were given the opportunity to review and edit survey questions. Edits included eliminating anything that may lead to identifying patients such as birth date, income, and ZIP code, which limited the amount of demographic data collected.

Survey methodology did not allow us access to respondent information to determine reasons for the low patient response rate, and clinics mailing the surveys were unable to do a second mailing due to staff time concerns. We do know that 138 of the surveys were returned to us by the Postal Service and speculate that those medically evaluated during the earliest timeframe of this study may have relocated. Additionally, not all respondents answered all questions, limiting calculation for statistical significance to select questions.

Validity

Because of the low response rate, we assessed the validity of our findings by looking at the randomness of responses and the comparability of available demographics of responders to non-responders and then compared findings with others published research.

Randomness

Responses received were spread across 43 of Wisconsin's 72 counties; the gender demographic of responders to non-responders was equal.

Comparisons

A comparison of respondent industry to the number of workers in each industry was not done since no publications exist regarding the number of workers who wear respirators in Wisconsin industries.

The OSHA respiratory protection standard requires that a documented program include an exposure assessment, selection criteria, medical evaluation, fit testing, and training.[6] A 2007 national study found half of all private sector establishments do not comply with this medical fitness evaluation requirement.[7] In addition to medical evaluation compliance, respondents reported that they received training in fit, usage, and maintenance on the job; however, a substantial number of survey participants did not answer this question, prompting us

to wonder if any training was received. This was reinforced when 1 respondent relayed respirator maintenance concerns and stated that he had developed WRA as a result of exposure to paint and mold due to infrequent respirator maintenance.

Work information needed to determine prevalence is not readily available. Surveys are thought to be a good way to collect prevalence data directly from the population studied, but due to methodology or question wording, there may be bias in the tool, and differences may exist. A 2006 Behavioral Risk Factor Surveillance Survey (BRFSS) found a 13% lifetime prevalence of asthma in Wisconsin and a WRA prevalence of 11% among those diagnosed with asthma.[8] The American Thoracic Society reports a median value of 15% is a reasonable estimate of the occupational contribution burden of asthma.[9,10] This met our goal of determining asthma/WRA prevalence among this population as we found 18% lifetime asthma prevalence and 18% WRA prevalence among those diagnosed with asthma, which seems reasonable. We were also able to gain information about the industries, occupations, and exposures of workers who wear respirators.

Findings

As expected, a statistical difference existed between the number and frequency of asthma symptoms and medications between those with asthma and those without. However, a quarter of those not diagnosed with asthma reported having asthma-like symptoms at least once a week. This is disconcerting, since any cough can adversely impact the effectiveness of a respirator by breaking the respirator seal and allowing an exposure.[11] We unexpectedly saw no difference between any of the 4 groups regarding medical clearance and job change.

This descriptive research project was undertaken to answer questions regarding workers who wear respirators and to assess the process to collect this information. Even with the low response rate, we believe data collected can be used as a baseline for further, more rigorous research to determine any correlations between respirator wear, asthma, and work.

CONCLUSIONS

Prior to this study, limited information existed on Wisconsin workers who wear respirators: their health, respirator medical evaluation efforts, industry/occupation, or exposure history. Despite some limitations, this project provided that insight.

We found that the majority of Wisconsin workers who were medically evaluated to wear respirators were Caucasian men not of Hispanic origin. These workers were evaluated multiple times during their work years, with an average of 3 tests prior to being fit with a respirator. Most were fitted with a canister-type or air-supplied respirator and wore their respirator to protect themselves most frequently from chemicals and dust in manufacturing and construction. Likely because statistical power was limited by small sample size, we found few statistically significant differences between those with asthma who wear respirators and those not diagnosed with asthma.

This information, along with prevalence data, can be used by health care professionals, especially those performing respirator use certification, to create work-related asthma awareness and prevention strategies.

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