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Use of State Workers' Compensation Data for Occupational Carpal Tunnel Syndrome Surveillance: A Feasibility Study in Massachusetts

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The purpose of this study was to determine the feasibility of using Massachusetts workers' compensation data for passive surveillance of occupational carpal tunnel syndrome (OCTS). Workers' compensation claims for OCTS (n = 358) and for possible cases of OCTS (n = 1,121) active during the first 6 months of 1989 were identified. The availability and distribution of demographic and employment descriptors were assessed. Medical records on a sample of the claims were reviewed to validate the diagnosis of OCTS. Age, gender, and occupation were available for less than 47% of the reported cases of OCTS. The majority (88%) of cases on whom medical record review was performed had a physician's diagnosis of carpal tunnel syndrome (CTS), and most of this group had confirmatory nerve conduction studies or electromyography. However, there were fundamental limitations to workers' compensation based disease surveillance in Massachusetts, including underascertainment of cases, potential ascertainment biases, delayed case reporting, limited access to specific diagnostic information, and incomplete and sometimes inaccurate information. These limitations are likely to be applicable in many, if not most, states and must be made clear in any analyses based on workers' compensation data. © 1994 Wiley-Liss, Inc.

Key words: repetition strain injury, occupational diseases, population surveillance, industry, occupation, workers' compensation data

INTRODUCTION

Repetitive trauma disorders (RTDs) are the most common category of occupationally related disease in the United States. Over half (56%) of all reported occu-

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pational illnesses were RTDs in 1990, representing a threefold increase in the relative incidence of these disorders over the previous decade [U.S. Department of Labor, 1992]. Ergonomic factors believed to cause these disorders include frequent repetitive movement of the hands, wrists, or fingers; use of high force or awkward hand postures; and vibration exposure [Silverstein et al., 1986, 1987; Wieslander et al., 1989]. Whereas the majority of high risk jobs occur in manufacturing industries, such as meat packing, poultry processing, and motor vehicle and car body production, work-related RTDs are found in all industrial sectors [U.S. Department of Labor, 1992]. Of the repetitive motion disorders associated with work-related exposures, occupational carpal tunnel syndrome (OCTS) is a commonly recognized example. Among workers in high risk jobs, the prevalence of OCTS has been estimated to be as high as 15% [Masear et al., 1986; Barnhart et al., 1991].

To develop a preventive strategy for work-related RTDs, industries and occupations at high risk for these diseases must be identified. In several states, including Washington and Ohio, workers' compensation claims have provided useful surveillance data for identification of local high risk industries and occupations [Tanaka et al., 1988; Franklin et al., 1991]. However, Washington and Ohio are two of only six states nationwide in which workers' compensation insurance is provided primarily by state administered funds [U.S. Chamber of Commerce, 1992]. Massachusetts, like most states, does not provide workers' compensation insurance to its local industries; employers obtain insurance in the private, commercial market. This absence of state insurance programs influences the structure, organization, and function of state workers' compensation agencies and their data.

The purpose of the current study was to determine the feasibility of using Massachusetts workers' compensation data for passive surveillance of OCTS. Because of its increased incidence, its relatively short latency, and its recognizability, OCTS was chosen as a test disease for surveillance using workers' compensation data. The availability and distribution of key demographic and employment data in the state's computerized workers' compensation database were examined. The diagnosis of OCTS was validated by reviewing medical information for a sample of potential cases.

METHODS

Workers' Compensation Data

With rare exceptions, Massachusetts law requires all private sector and some public sector (government) employers to maintain workers' compensation insurance coverage. Either the affected employee or his/her employer can initiate a claim for workers' compensation. Response to the compensation request is the responsibility of the employer and the employer's insurer. Compensation claim records are maintained by the state Department of Industrial Accidents (DIA), which monitors the process and adjudicates disputes within the system.

Under amendments enacted in 1986 and applicable at the time of this study, Massachusetts employers covered by the state's workers' compensation laws were required to file a report (the *employer's first report*) with the DIA for every employee who loses 5 or more working days due to a work-related injury or illness. This report initiates a compensation claim. If an employer does not report a work-related illness or injury to the DIA, the employee can initiate a claim for workers' compensation by

sending an *employee's claim form* to the DIA. Selected data from the employer's first report and from employees' claims are entered into a computerized database at the DIA.

In addition, as compensation claims involve insurers and third parties (medical care providers, for example), other groups are required to send information to the DIA. Some of this information is entered into the same computerized database. However, employer and third party compliance with reporting requirements is not formally monitored. As a consequence, workers' compensation claims may be filed with an insurer without being reported to the DIA.

The computerized database is designed to include the following employee information: name, date of birth, gender, usual occupation, employer's name and Standard Industrial Classification (SIC) code, date of injury, descriptive information about the injury, and an American National Standards Institute (ANSI) code for the nature of the injury or illness, as well as an ANSI code for the affected body part [Office of Management and Budget, 1987]. ANSI and SIC codes are not assigned by the DIA staff. Instead, persons (employers, employees, or their representatives) completing the forms select the relevant ANSI and two-digit SIC codes from a list provided on the back of the reporting form. Since 1987 a specific code for carpal tunnel syndrome (CTS) has been included among the nature of injury codes listed on the back of these forms.

Medical information and physician statements are kept at the DIA primarily for use in cases involved in dispute resolution or adjudication. This medical information is not computerized.

Study Population

Compensation claims that were active during the first 6 months of 1989 were identified. Specifically, all cases that met at least one of the following criteria between January 1, 1989 and June 30, 1989 were studied: (1) an employer or employee had initiated a compensation claim; (2) an insurer had agreed to compensate or pay some portion of a claim; (3) an insurer had requested termination of compensation benefits for a claim; (4) a third party had requested reimbursement for services related to the claim; or (5) an employee had disputed the disposition of his/her claim request. This selection process did not provide information on the final disposition of claims. We could not ascertain whether the presumptive work-relatedness of claims was confirmed or denied. Instead, we made the assumption that filing a workers' compensation claim indicated strong suspicion of work-relatedness on the part of an employer, employee, and/or health care provider.

To extract potential cases of OCTS from this group, reports with a nature of injury code for CTS were identified. Furthermore, all reports with ANSI codes for inflammation, sprains and strains, or nervous system conditions that involved at least one body part from the upper extremities, wrist, hand, or fingers were identified. A total of 2,500 cases were selected in this way. To eliminate potential duplicate representations of the same injury, only information from the first claim for the same injury type in a given employee was retained for analysis. A total of 2,451 unique cases remained after this adjustment (Fig. 1).

There were 358 cases with a CTS code among the population of 2,451. These were categorized as *probable* cases of OCTS. Of the remaining 2,093 cases without a CTS code, 972 were eliminated because they had descriptive information suggest-

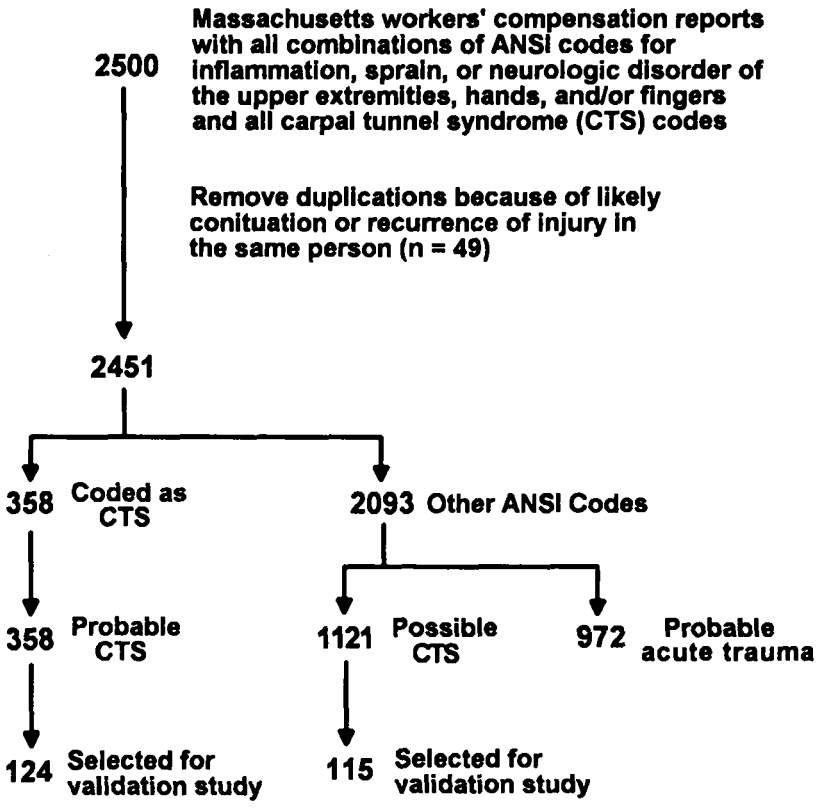

Fig. 1. Massachusetts Workers' Compensation Study Population for Surveillance of Occupational Carpal Tunnel Syndrome, January 1–June 30, 1989.

ing acute traumatic injury. Specifically, cases with injury descriptions such as "laceration," "amputation," "fracture," "crush injury," "fell from," or "struck by" were excluded. The remaining 1,121 were categorized as *possible* cases of OCTS (Fig. 1).

Validation of Diagnosis

To assess the validity of using Massachusetts workers' compensation data for OCTS surveillance, we reviewed the DIA's medical information on a sample of the *probable* OCTS cases. Similarly, DIA medical information on a sample of *possible* cases was reviewed to determine if additional OCTS cases were classified by more general ANSI codes.

Medical information is generally only available at the DIA for cases that involve disputed compensation, and an *employee's* or *third party's claim form* is frequently filed in disputed cases. We preferentially sought hard-copy records for cases with these forms because of the greater likelihood of finding medical records. Probable and possible cases were sorted alphabetically by the first four letters of the last name and by the availability of an employee's or third party's claim form in the DIA records. For possible cases (those without a CTS code), a partial sorting of records by body

part was also performed such that injuries of the hand, wrist, or fingers took precedence over injuries of the upper extremity. Using the two sorted lists, the first 124 (35%) probable cases and the first 115 (10%) possible cases with hard copy records available for review were identified for a validation study (Fig. 1).

In the hard copy record review of the probable and possible cases sampled, we completed any demographic and employment data missing from the DIA computerized data. Where medical information was available in the hard copy file, a physician's diagnosis of CTS and the presence of symptoms, objective findings, and occupational risk factors necessary to assess conformity with the National Institute for Occupational Safety and Health (NIOSH) criteria for a surveillance case definition of OCTS were noted [Matte et al., 1989].

Occupation and Industry Coding

Occupation codes were not available in the DIA database and Standard Industrial Classification (SIC) Codes were incomplete. Assignment of both occupation and industry codes was attempted for all probable OCTS cases. Three digit occupation codes based on the Bureau of Census Coding system were assigned by trained coders from the Registry of Vital Records, Massachusetts Department of Public Health [U.S. Bureau of the Census, 1980]. Three digit SIC codes were obtained from several sources in the following priority: the Massachusetts Department of Commerce, Dun and Bradstreet publications, and the Massachusetts Office of Business Development [Dun's Marketing Service, 1989, 1990a,b; Dun and Bradstreet Corporation 1991].

Some employers had more than one possible SIC code. Furthermore, a few cases had more than one job in a given industry category. Because this was infrequent, the first SIC code and the first occupation category entered in the computer file for a given case were used in our analyses.

Data Analyses

Descriptive data analyses were performed using the SAS (Statistical Analysis System) computer software package from the SAS Institute, Cary, North Carolina. For the analysis of demographic and employment distributions, the age, gender, and industrial sector distributions of full- and part-time Massachusetts workers in 1989 were obtained from the Massachusetts Department of Employment and Training and the U.S. Department of Labor [Massachusetts Department of Employment and Training, 1989; U.S. Department of Labor, 1989].

RESULTS

Demographic Data

At the time of this study, the employer's first report of injury was the only source of the employee's date of birth, gender, and occupation in the DIA computerized data. (A revised employee's claim form that requests employee date of birth and occupation should be available from the DIA sometime in 1993.) Although demographic and employment information are requested on employer's first reports, these data are not always provided by the employer. Employer's first reports were available on 47% of the probable OCTS cases but, because of missing information on these reports, age, gender, and occupation were available on less than 47% of prob-

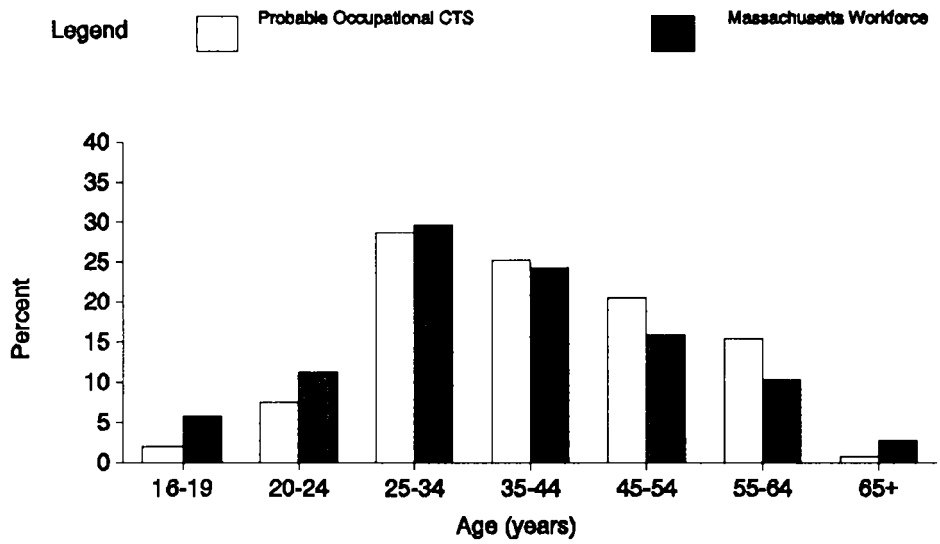

Fig. 2. Age distribution of probable occupational carpal tunnel syndrome cases reported to Massachusetts workers' compensation, January 1–June 30, 1989. Bars represent the percent of probable occupational carpal tunnel syndrome (OCTS) cases in each age group compared with the percent of Massachusetts workers of the same age in 1989 [Massachusetts Department of Employment and Training, 1989]. Age was available for 254 (71%) of OCTS cases reported to Massachusetts workers' compensation during the first 6 months of 1989.

able OCTS cases. Employer's first reports were available for 88% of cases eliminated from our analyses as likely acute traumatic injuries.

Where available, the age distribution of probable OCTS cases was similar to that of the Massachusetts workforce in 1989, with most (74%) cases occurring in 25 to 54 year olds (Fig. 2) [Massachusetts Department of Employment and Training, 1989]. Over half (54%) of these probable cases were less than age 40. Among the 292 (82%) probable OCTS cases where gender was known, female workers were involved approximately twice as often as males. In contrast, over half (53%) of the Massachusetts workforce in 1989 was male [Massachusetts Department of Employment and Training, 1989].

Industry and Occupation

SIC code information was missing in the DIA computerized database from approximately 40% of probable OCTS cases. Of those cases with SIC codes, 20% were coded as nonclassifiable establishments, and over half (59%) were limited to two, rather than the optimum of four, digits. Two digit SIC codes are descriptive of broad industrial sectors (manufacturing or construction, for example), whereas four digit codes are industry specific.

We obtained three digit SIC codes for 348 (97%) of the 358 probable cases of OCTS. The majority, 198 or 57%, of industries represented in this population were broadly categorized as manufacturing (Fig. 3). In contrast, only 21% of Massachusetts industry was categorized as manufacturing in 1989 [U.S. Department of Labor, 1989]. Service and trade (retail and wholesale) industries were the next most common

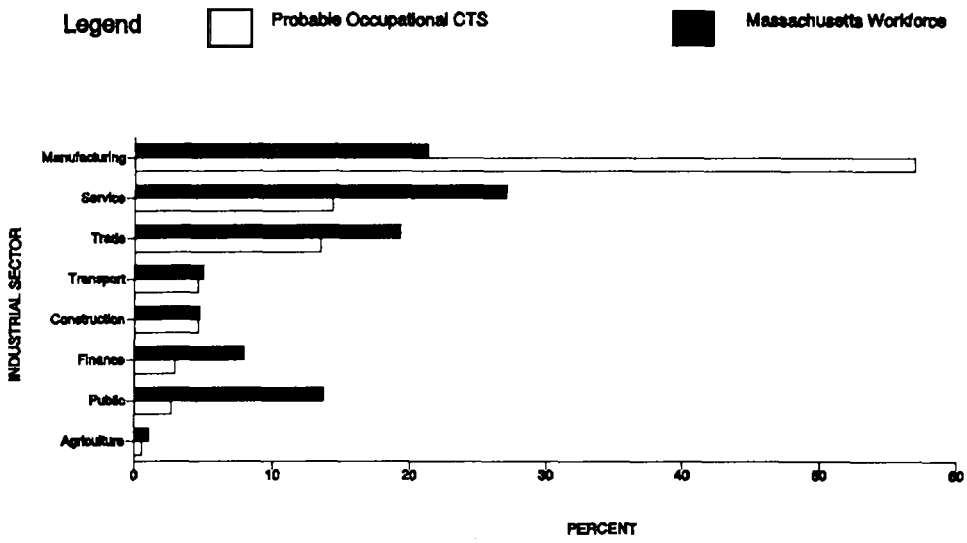

Fig. 3. Employment distribution of probable occupational carpal tunnel syndrome cases reported to Massachusetts workers' compensation, January 1–June 30, 1989. Bars represent the percent of probable occupational carpal tunnel syndrome (OCTS) cases employed in a given industrial sector compared with the percent of Massachusetts workers employed in the same sector during 1989 [U.S. Department of Labor, 1989]. Industrial sector information was obtained on 348 (97%) of OCTS cases reported to the Massachusetts workers' compensation system during the first 6 months of 1989.

with 50 (14%) and 47 (13.5%) of probable OCTS cases employed in these sectors. For Massachusetts in 1989, 27% of the state's employees were in the service sector and approximately 19% were in the trade sector [U.S. Department of Labor, 1989]. When more specific industry categories were reviewed, grocery stores (SIC code 541) in the trade (retail) sector employed the largest absolute number (17 or 5%) of probable OCTS cases.

Occupation codes were obtained on 251 (70%) cases of probable OCTS. The majority (55%) of these 251 occupations were broadly categorized as operators, fabricators, and laborers; the most frequent occupations were machine operators, assemblers, and inspectors, which included 108 or 43% of the probable cases overall. The second most frequent broad occupational group—technical, sales, and administrative support occupations—represented 19% of the available occupation codes, followed by precision production, craft, and repair occupations with 14% of the available occupation codes. The most common occupations of the probable OCTS cases working in grocery stores were butchers/meat cutters and packers/packagers.

Date of Injury

Information filed at the DIA during the first 6 months of 1989 included a number of cases with injuries or illnesses that had allegedly occurred before 1985. However, the majority (67%) of probable OCTS cases with active DIA files during this 6 month interval were related to disorders that reportedly began between January 1, 1988 and June 30, 1989.

TABLE I. Validation Criteria for the Diagnosis of Occupational Carpal Tunnel Syndrome (OCTS) in Massachusetts Workers' Compensation Cases, January 1–June 30, 1989

Medical data	Probable OCTS selected for validation study (n = 124)	Possible OCTS selected for validation study (n = 115)
Medical information reviewed[a]	77	76
Physician diagnosis of carpal tunnel syndrome[b]	68	18
Nerve conduction and/or electromyography confirmation[c]	42 (62%)[d]	13 (72%)
Fulfill NIOSH criteria for OCTS[e]	12 (18%)	2 (11%)
Insufficient data to determine if fulfill NIOSH criteria[e]:	56 (82%)	16 (89%)
No job description in state data	10	3
Classic median nerve distribution of findings not described	33	8
No symptom history and/or no physical exam	13	5

[a]Overall, medical information was reviewed for 77/358 of probable OCTS cases and 76/1121 of possible OCTS cases.
[b]Probable cases without a physician's diagnosis of CTS include cases with other repetitive trauma disorders in addition to cases for which no diagnosis was available in the DIA medical data.
[c]The cases which did not have nerve conduction or electromyography confirmation of CTS were not tested, did not have test results available in the state's records, or had normal (n = 1) results.
[d]Percents are based on the subset of cases with a physician's diagnosis of carpal tunnel syndrome.
[e]Matte et al. [1989].

Validation of Diagnosis

Two populations were of interest in our validation analyses (Fig. 1): the 124 cases with CTS codes (probable OCTS cases) and the 115 cases without CTS codes (possible OCTS cases) for whom detailed review of original records was possible (total n = 239).

Medical records were available at the DIA for 64% (153/239) of those for whom detailed hard copy record review was undertaken. Of the probable cases with medical records, 88% (68/77) had a physician's diagnosis of CTS (Table I). The remaining 12% included cases for which no diagnosis was available, in addition to cases of other disorders potentially attributable to repetitive trauma, such as de Quervain's tenosynovitis and ulnar nerve entrapment. Twenty-four percent (18/76) of the possible cases with medical records had a physician's diagnosis of CTS (Table I).

Most cases with a physician's diagnosis of CTS also had nerve conduction study (NCS) and/or electromyography (EMG) results consistent with this diagnosis (Table I). For the majority of cases without diagnostic NCS/EMG results, the tests were either not performed or the results were not available in the DIA record. There was only one case of physician diagnosed CTS with normal NCS/EMG results available in DIA records. Of note, however, was the finding that most cases with a physician's diagnosis of CTS had insufficient information available in the DIA medical data to determine whether they met the NIOSH criteria for a case of OCTS (Table I).

DISCUSSION

Case Ascertainment

Use of state workers' compensation data as a surveillance system for work-related RTDs is likely to underestimate the prevalence of these diseases because their

work-relatedness is frequently overlooked and because many qualified workers never apply for workers' compensation benefits [Fine et al., 1986; Armstrong, 1986; Seligman et al., 1986; Pollack et al., 1987]. Our use of the Massachusetts workers' compensation data for OCTS surveillance identified additional reasons for underascertaining cases in this database. For example, although the DIA maintains records of compensation claims, Massachusetts employers are not required to notify the DIA of work-related illnesses that involve less than 5 days of lost work time or incapacity.

Excepting cases for which arbitration or conciliation hearings are required, the Massachusetts DIA is not directly involved in the workers' compensation process. As a result, for all workers' compensation cases, regardless of the duration of disability, the agency has no clear rationale or mechanism for assessing the frequency of unreported claims. For cases with limited disability (less than 5 days), claims for workers' compensation benefits can be made to employers' insurers, and insurers' payments can be provided without reporting to the DIA. In the majority of other states where, like Massachusetts, private insurers provide the workers' compensation insurance coverage for local industries, the workers' compensation or industrial accident agency is likely to play a similarly peripheral role in many workers' compensation cases. As a result, the above limitations are likely to hamper surveillance efforts in these states. Furthermore, the requirement of some minimum lost work time or disability period prior to reporting work-related injuries or illnesses to the state has been described in other settings where the state is not the insurer [Seligman et al., 1986; Oleinick et al., 1993].

It is likely that compliance with state reporting requirements varies by industry and over time. Nonrandom variability in reporting patterns could impose further limitations on accurate surveillance via workers' compensation. For example, if high risk industries were less compliant with state reporting requirements than safer environments, these high risk workplaces would be less easily identified via workers' compensation claims and any intervention activity might be misdirected to low risk industries.

Despite its short latency compared with other occupational diseases, the symptoms of OCTS usually develop gradually without requiring a single insult, and thus recognition of its job-relatedness can be delayed. At least in Massachusetts, this means that OCTS claims are not initiated with an employer's first report as readily as are claims for acute traumatic injuries. As a result, sole reliance on employers' first reports or an analogous reporting system further limits the inclusiveness of OCTS surveillance via workers' compensation data.

Data Quality

Missing data and poor quality data are potential limitations to any workers' compensation database, particularly in those 44 states that do not act as primary insurers for local industry. For example, in Massachusetts demographic and employment data were available on less than half of the population that was most useful for OCTS surveillance. In contrast, Washington State has more complete demographic and employment information in its workers' compensation data [Franklin et al., 1991]. Indeed, self-insured industries were excluded from Washington's workers' compensation surveillance analyses of OCTS because of incomplete data [Franklin et al., 1991].

Lastly, Massachusetts does not have medical information linked to the state's

computerized workers' compensation database. As a result, validation of both the diagnosis and work-relatedness of potential OCTS cases is difficult. To our knowledge, Washington is the only state that has been able to identify workers' compensation cases of OCTS using computer-linked medical information [Franklin et al., 1991].

Demographic and Employment Characteristics

Because the data presented here were obtained in a feasibility study, the number of probable OCTS cases available for study was small (n = 358). Despite these limitations, the age and gender distribution of our cases were similar to those reported in other workers' compensation-based RTD surveillance studies in which much larger cohorts were evaluated [Tanaka et al., 1988; Franklin et al., 1991]. Our probable cases of CTS were most likely to be employed in the manufacturing sector in jobs categorized as machine operators, assemblers, and inspectors. We may have overrepresented manufacturing because our first source of SIC code data was limited to manufacturing industries (the Massachusetts Department of Commerce data). As a result of this SIC code assignment protocol, several local industries that have multiple SIC codes, including manufacturing, would consistently be assigned to the manufacturing sector [Dun's Marketing Services, 1990a]. Given the dominance of manufacturing in our results, this limitation is unlikely to change the trend that a greater proportion of our cases were employed in manufacturing jobs than would be expected from the distribution of the Massachusetts workforce [Tanaka et al., 1988; Franklin et al., 1991]. The similar demographic and employment characteristics of the Massachusetts cases and cases from larger, workers' compensation-based surveys of OCTS in other states suggests that, despite limitations, the Massachusetts workers' compensation data do provide some useful information [Tanaka et al., 1988; Franklin et al., 1991].

Validation of Diagnoses

To our knowledge, validation of workers' compensation-derived diagnoses has not been reported in states that do not provide workers' compensation insurance to local industries. Furthermore, other states have used more general ANSI codes to identify likely OCTS for surveillance purposes [Hanrahan et al., 1991; Tanaka et al., 1988]. Because of resource limitations and missing medical information, validation of the diagnosis of OCTS in the Massachusetts data was based on review of a small number of cases. Our record review process was not random with respect to claim form availability although two thirds of the probable OCTS cases had these forms.

Given the demographic and employment similarities between sampled and unsampled cases (Table II), we believe that significant bias from our selection process is unlikely. Among cases where medical information was reviewed, a specific code for CTS was a good indicator of the disease and was substantially better than the use of more general ANSI code descriptors. However, reliance on a CTS code alone underestimated the frequency of cases as we found additional physician-diagnosed cases of CTS among more general ANSI codes. Unfortunately, some of the medical information we reviewed lacked sufficient detail to determine work-relatedness (Table I). Given the presence of these cases in the state's workers' compensation system, we believe the assumption of work-relatedness is reasonable for hazard surveillance purposes.

TABLE II. Probable Occupational Carpal Tunnel Syndrome Cases (n = 358) Reported to Massachusetts Workers' Compensation, January 1–June 30, 1989: Cases With and Without Medical Information Reviewed

	Medical data reviewed, n = 77	No medical data reviewed, n = 281	Massachusetts workforce, 1989[a]
Claim form available[b]	77 (100%)	160 (57%)	N/A[c]
Female	50 (65%)	146 (52%)	1,445[d] (47%)
Male	27 (35%)	69 (25%)	1,608[d] (53%)
Missing gender	0	66 (23%)	N/A
Female/male	1.9	2.1	0.9
Mean Age in years (SD)	39.9 (11.7)	40.3 (12.5)	N/A
Age range	20–63	18–67	N/A
Employed in manufacturing[e]	41 (55%)	157 (57%)	601[f] (21%)
Employed in service[e]	11 (15%)	39 (14%)	766[f] (27%)

[a]Massachusetts Department of Employment and Training [1989]; U.S. Department of Labor [1989].
[b]Any of multiple forms used by (1) employees seeking compensation or responding to denied compensation, (2) insurers seeking to end compensation, or (3) third parties seeking reimbursement.
[c]Not applicable or not available.
[d]Numbers are in thousands. Figures apply to full- and part-time employees.
[e]The figures apply to cases for which employment sector information was obtainable. These data were missing for 3 (4%) cases for which medical data review was performed and 7 (2%) cases for which medical data review was not done.
[f]Numbers are in thousands. Figures apply to full- and part-time employees but exclude self-employed individuals who are not covered by the state's workers' compensation laws.

Incident Case Reports

The distribution of injury dates in our population suggests that while workers' compensation data can identify incident compensation-related reports of probable OCTS in a given year, the actual incidence of disease onset captured by this system will span at least several years. This is consistent with a disease that can develop months to years after the first exposure to its risk factors. During this lag period other workers may be exposed to risk factors for RTDs. As a result, it may be difficult to establish timely intervention programs based on workers' compensation reporting patterns. Some of the analytic problems associated with the time lag between workers' compensation claim reports and disease onset have been described in detail elsewhere [Oleinick et al., 1993].

To estimate the effect of job exposures on the development of OCTS, a measure of disease incidence is useful. The standard denominator used for these estimates in occupational illnesses is full-time equivalent employees. Although the U.S. Department of Labor publishes yearly descriptive reports on the incidence of occupational illnesses and injuries by industry, these data are based on national sampling schemes and do not provide state specific information [U.S. Department of Labor, 1992]. Unfortunately, during the study period Massachusetts, as well as Colorado, New Jersey, New York, Ohio, Pennsylvania, and Wisconsin, did not collect complete information on the number of full-time equivalent employees in the state by industry [U.S. Department of Labor, 1991a, 1992]. Data in these states were based on employment and unemployment figures, which do not distinguish between full- and

part-time employees [U.S. Department of Labor, 1988]. Given the limitations of workers' compensation-derived case report estimates, and the lack of appropriate denominator data in many states, it is difficult to make meaningful comparisons of disease incidence changes over time or between different states, industries, and occupations. Reforms in the Bureau of Labor Statistics (BLS) national occupational injury and illness reporting systems have been initiated since the time of this study [U.S. Department of Labor, 1991b]. In association with these reforms, Massachusetts will improve its denominator data for future analyses. Furthermore, the lack of good denominator data in many states does not preclude using workers' compensation data to monitor case reports.

CONCLUSIONS

According to Massachusetts' workers' compensation data, a relatively young population is afflicted by OCTS. The morbidity, lost productivity, and medical costs associated with OCTS in Massachusetts, and elsewhere, are likely to be substantial. A program aimed at disease prevention, particularly for workers in industries and occupations with a large number of cases, would be a valuable public health service to the state's workers and their employers. Given the absence of other state specific data [Anderson et al., 1989] or an established and comprehensive national program [Balmes et al., 1992] for occupational disease surveillance, workers' compensation data have the potential to be an important tool for occupational disease prevention.

However, there are fundamental limitations to workers' compensation-based disease surveillance which must be made clear in any analyses based on these data. Most important among these limitations are underascertainment of cases, potential ascertainment biases, delayed case reporting, limited access to specific diagnostic information, and poor data quality, including incomplete and inaccurate information. These limitations are likely applicable in many, if not most, states.

In the absence of alternatives, the mere availability of state workers' compensation data recommend them as an acceptable source of OCTS surveillance data. However, because workers' compensation systems are state specific, the appropriateness and utility of these data for occupational disease surveillance vary by state. Our experience suggests that Massachusetts' workers' compensation data have more limitations than Washington's analogous database, for example. We hypothesize that some of Massachusetts' weaknesses and Washington's strengths are related to the characteristic of different insurance provider systems in each state. Unfortunately, the Massachusetts insurance system is typical of most other states [U.S. Chamber of Commerce, 1992].

The development of consistently useful databases for OCTS and other occupational disease surveillance is still in its infancy. Based on the Massachusetts experience with OCTS, revamping the coding systems used by workers' compensation to incorporate specific diseases would improve the utility of these data for OCTS surveillance. Enhancing the system to capture more complete demographic and employment data would also improve its utility. Given its more fundamental limitations, the use of state workers' compensation data in combination with physician reporting systems, laboratory reporting systems, and national data from the Bureau of Labor Statistics, for example, may be the most effective means of occupational disease surveillance.

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