**HETA 92-0268-2477**
**DECEMBER 1994**
**OHIO CHAPTER, REGISTRY OF INTERPRETERS FOR THE DEAF**

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## I. SUMMARY

In May 1992, the Ohio Chapter of the Registry of Interpreters for the Deaf (OCRID) requested the National Institute for Occupational Safety and Health (NIOSH) to evaluate the problem of musculoskeletal disorders among interpreters for the deaf. In response, NIOSH conducted an investigation among active members who attended a conference held by the national Registry of Interpreters for the Deaf (RID) for Region III in Cleveland, Ohio, in September 1992. The evaluation included a self-administered questionnaire which obtained data on musculoskeletal symptoms of the upper extremity (neck, shoulders, elbows, fingers, hands, and wrists) and low back. If the symptoms occurred in the past year, more information was obtained regarding the symptom's onset, duration, frequency, and severity. All participants completing the questionnaire were offered a physical examination of their upper extremities. The standardized examination consisted of inspection, palpation, passive movements, resisted movements, and a variety of maneuvers to define upper extremity musculoskeletal conditions.

For analysis, two case definitions were created based on the questionnaire and physical examination: "symptom" cases based on questionnaire data, and "symptom-exam" cases based also on physical exam findings. Associations between workplace factors and the two case definitions were assessed by multiple logistic models generated for each area of interest: neck, shoulders, elbows, fingers, hands, and wrists. A total of 106 individuals were included in the analysis of the symptom questionnaire data, and 105 in the analysis of the examination data. Approximately 86% of the participants were female.

More than 92% of the participants reported symptoms in at least one part of the body during the year prior to the study. Of those reporting discomfort in a particular site, up to 64% also reported that symptoms occurred in the week prior to the study. For each body site, at least 32% of the respondents reporting discomfort during the past year described it as moderate to severe. Over 20% of participants met the symptom case definition for the shoulder, elbow, and fingers, and more than 30% met the symptom case definition for the neck and hand. Only 8% met the case definition for the back. In the logistic regression models, statistically significantly elevated age- adjusted odds ratios were found for neck and finger symptoms in sign language interpreters who worked for 10 or more years relative to those working less than one year, and for shoulder pain in sign language interpreters who worked, on average, more than 20 hours per week.

Approximately 23% of the study participants were found to have tenderness or pain in the hand/wrist area upon palpation or manipulation during the physical examination. For the elbow area, 6.7% of participants had such findings. The case definition was met by 13% of the participants; 9% met the case definition for the hand/wrist area; 3% met the case definition for carpal tunnel syndrome. Prevalence rates of neck, elbow, finger, or shoulder disorders were each less than 2%.

Several sources of potential bias could have influenced the results and interpretation of the results, including study design limitations and exposure misclassification.

The major findings of this evaluation were: (1) The prevalence of upper extremity musculoskeletal disorders based on positive symptoms and positive physical exam findings was low. (2) This study suggests that symptoms associated with work-related musculoskeletal disorders of the shoulders in sign language interpreters are related to the number of hours that an individual interprets per week, and symptoms associated with work-related musculoskeletal disorders of the neck and fingers are related to the length of employment as a sign language interpreter.

The observed prevalence of symptoms associated with work-related musculoskeletal disorders was consistent with high biomechanical demands of the job as described by previous studies. Recommendations to prevent and reduce biomechanical stress are contained in Section VIII of this report.

**KEYWORDS:** SIC 9999 (Nonclassifiable Establishment), sign language interpreters, musculoskeletal disorders, shoulder pain, elbow pain, carpal tunnel syndrome

## II. INTRODUCTION

In May 1992, the Ohio Chapter of the Registry of Interpreters for the Deaf (OCRID) requested the National Institute for Occupational Safety and Health (NIOSH) to evaluate the problem of musculoskeletal disorders among interpreters for persons who are deaf. In response, NIOSH conducted a survey of musculo-skeletal disorders among professionally active sign-language interpreters who attended the RID Region III Conference in September 1992. The main objectives of the evaluation were to determine the prevalence of musculoskeletal disorders and to characterize the occupational risk factors among sign language interpreters for the deaf.

## III. BACKGROUND

There is widespread recognition that work-related musculoskeletal disorders are common and increasing in the United States (Bureau of Labor Statistics, 1993). Between 1982 and 1992, the reported number of musculoskeletal disorders of the upper extremity has steadily increased, accounting in 1992 for more than 60% of all occupational illnesses (Bureau of Labor Statistics, 1993). Depending on the job, these disorders may cause pain, restricted motion, and weakness in the hands, arms, shoulders, neck, back, and lower limbs. Coupled with the human costs in suffering and lost wages, work-related musculoskeletal disorders are responsible for growing costs as evidenced by increases in worker's compen-sation costs, as well as escalating costs of diagnosis and treatment. Total compensable costs to the nation for these disorders is estimated to exceed $20 billion annually (Webster and Snook, 1994a,b).

In the United States, sign language is the fourth most commonly used language. Sign language interpretation involves translation of the spoken word into a physical form using predetermined motions, usually of the hands, which may be accompanied by facial expressions. Sign language interpreters work at schools for the deaf, social service agencies, conferences and seminars, courts, and elsewhere.

Though not extensively studied, sign language interpreters are at risk for work-related musculoskeletal disorders due to the repetitive nature of the job (Hagberg et al., 1987; Meals et al., 1988;Feuerstein and Fitzgerald, 1992; Cohn, 1990). Case reports suggest that use of sign language by both deaf individuals and sign language interpreters may have contributed to shoulder tendinitis in a deaf person (Hagberg et al., 1987) and to shoulder bursitis, flexor tenosynovitis, radial tunnel syndrome, lateral epicondylitis, and carpal tunnel syndrome in six sign language interpreters (Meals et al., 1988). Two other reports suggest that sign language interpreters may experience signs and symptoms consistent with work-related musculoskeletal disorders of the upper extremities (Feuerstein and Fitzgerald, 1992; Cohn, 1990). Both evaluations

were conducted after numerous reports of upper extremity pain brought on by interpreting and relieved by rest. Thirty-one percent of 80 interpreters in one study (Cohn, 1990) and 60% of 42 different full-time interpreters in the second study (Feuerstein and Fitzgerald, 1992) experienced signs or symptoms suggestive of work-related tendinitis, nerve entrapment disorders, or myofascitis of the upper extremities. Depending on the severity of the disorders, the interpreters lost work time or worked a reduced interpreting load.

## IV. METHODS

### A. Study Population

The Registry of Interpreters for the Deaf is a national organization with more than 4,000 members. RID certifies interpreters, maintains a registry of certified interpreters and transliterators (signed code for English), and supports activities of organizations of and for hearing impaired persons. The Ohio chapter includes certified interpreters from the states of Ohio, Kentucky, Indiana, Illinois, Michigan, Wisconsin, and Minnesota. The study was conducted using sign language interpreters who attended the conference and who volunteered to participate in the study.

### B. Medical Evaluation

The conference was held in a large hotel in downtown Cleveland, Ohio. To recruit participants, a letter describing the study was sent to all conference pre-registrants. At the conference site, a booth was set-up in the exhibit area. Pamphlets describing the study and NIOSH were passed out to conference attendees; posters describing the study were placed in strategic locations throughout the conference area. NIOSH employees were present at the booth during the conference to describe the study and enlist study volunteers. The medical evaluation was offered to all conference attendees who were sign language interpreters, including students. Small meeting rooms were used to conduct the physical examinations. The evaluation included a self-administered questionnaire which addressed musculoskeletal symptoms of the upper extremity (neck, shoulders, elbows, fingers, hands, and wrists) and low back. If the symptoms occurred in the past year, more information was obtained regarding the symptom's onset, duration, frequency, and severity. The questionnaire also collected information on age and pre-existing conditions related to non-occupational musculoskeletal disorders (diabetes mellitus, rheumatoid arthritis, lupus, thyroid disease, disc disease in the low back or neck, alcoholism, gout, and kidney disease), and traumatic or acute injuries to the area of interest. Occupational history was also obtained and included amount of time spent per week working as a sign language interpreter, preferred method of signing, and usual location of interpreting jobs.

The structure of the medical history questionnaire was adopted from a survey constructed by the University of Michigan and modified by NIOSH investigators for health hazard evaluations of work-related musculoskeletal disorders (Silverstein et al., 1986; Hales et al., 1989; Baron et al., 1991; Hales et al., 1992; Bernard et al., 1993). It was further revised for this study and is shown in Appendix A.

All participants completing the questionnaire were offered a physical examination of their upper extremities. The standard examination consisted of inspection, palpation, passive movements, resisted movements, and a variety of maneuvers to define upper extremity musculoskeletal conditions. The examining physician was blind to the participants' symptom histories. The structure of this instrument was adopted from an examination constructed by the University of Michigan and modified by NIOSH investigators for health hazard evaluations of work-related musculoskeletal disorders (Silverstein et al., 1986; Hales et al., 1989; Baron et al., 1991; Hales et al., 1992; Bernard et al., 1993). It was further revised for this study, and findings were entered directly into a laptop computer by the examining physician (Appendix B).

C. Case Definitions

**Outcome variables**
**Case definition for work-related musculoskeletal disorders:**

Based on the questionnaire and physical examination, two case definitions were created: "symptom" cases based on questionnaire data; and, "symptom-exam" cases, based on both questionnaire data and physical exam findings. The case definitions and rationale for such are listed below. For either case definition, the following criteria were also required: (1) No previous acute injury to the joint; (2) Symptoms began after becoming a sign language interpreter. If a subject met the case definition criteria (below) but did not satisfy the above two criteria, the subject was not included in the analysis for that body site.

A **symptom case** was defined as one or more symptoms (pain, aching, stiffness, burning, numbness, or tingling) in the neck, shoulder, elbow, hand, one or more fingers, wrist, or back which lasted more than one week or occurred at least once per month within the past year (12 months). A **symptom-exam case** was defined as a positive physical exam for the related joint or area (Appendix C) in addition to the symptom case criteria.

A positive physical sign included pain on passive or resisted motion of the joint or limb, tenderness during palpation, or a positive Phalen's or Tinel's test.

D. Statistical Analysis

The unadjusted number and prevalence of all reported symptoms and physical examination findings (collectively for each body area) were calculated for each body part (neck, shoulder, hand/wrist area, fingers, and low back.) The number and prevalence of both case definitions were then calculated.

Logistic analyses or, in the presence of zero cells, contingency table analyses, were used to test the relationship between the probability of being a case and the average number of hours worked per week as an interpreter, the number of years worked as an interpreter, and the preferred signing method. Likelihood ratio tests were used for logistic analyses, and chi-square (if valid) or Fisher's exact tests were used for contingency tables. When relationships with contin-uous variables were found, logistic analysis was used to test for a quadratic effect. All logistic regression analyses for each body site were adjusted for age as a continuous variable and sex. Back symptoms were not included in the regression analyses due to small sample size. Due to the small number of symptom-exam cases, these analyses were limited to symptom cases only. The number of hours worked as an interpreter each week was divided into three categories: less than 10 hours, 10-20 hours, and more than 20 hours. These categories were chosen because (a) the RID has recommended a weekly limit of 20 hours of interpreting, (b) based on informal discussions with interpreters, many work less than 20 hours, (c) and the distribution of the number of hours worked per week easily fit into these categories.

Odds ratios were calculated by exponentiating the estimated parameter (Beta) of the respective logistic models. To evaluate the magnitude of the odds ratios, 95% confidence intervals were calculated for each.

## V. RESULTS

Of 164 sign language interpreters registered for the conference sessions, 109 (66%) volunteered to participate in the study. All completed the medical history questionnaire, and all but one completed the physical exam. Two subjects reported having lupus and were not included in the study. One participant was pregnant and was also excluded, leaving 106 for analysis of the symptom questionnaire data and 105 for the physical examination data.

Approximately 86% of the participants were female. At the time of the study, the mean age of the participants was 36 years (standard deviation 8 years). The youngest participant was 20 years old, the oldest 69. Table 1 describes the pre-existing medical conditions in the study group after excluding two subjects with lupus and one who was pregnant. With the exception of the two individuals who reported having lupus, the study participants did not appear to have chronic health problems that would predispose them to nerve entrapment syndromes or other musculoskeletal disorders. The distribution of average number of hours worked per week is given on Table 2. Approximately equal numbers of interpreters worked less than 10 hours per week or 10-20 hours per week and somewhat fewer worked more than 20 hours per week. On average, the participants worked as sign language interpreters approximately 15 hours per week during the past year, although at least one individual reported working a maximum of 47 hours per week. The average length of employment for the group was 6.5 years; the longest was 20 years. Fifty-two percent of the participants reported that they most often used American Sign Language (ASL), while another one-third most often used transliteration (Table 3).

Table 4 presents the prevalence of symptoms (pain, aching, stiffness, burning, numbness or tingling) in the past year for each of the body sites of interest. More than 92% of the participants reported symptoms in at least one part of the body, and 79% reported pain in two or more areas of the body. Between 42% and 65% of sign language interpreters who reported symptoms in the past year also reported that symptoms occurred in the week prior to the study. For each body site, at least 32% of the respondents described the discomfort level during the past year as moderate to severe. With the exception of back pain, more than 50% of participants reporting symptoms attributed them to sign language interpreting (Table 5). Over 30% of this group reported seeing a health care provider for the symptom, yet less than 13% missed one or more days of work.

Table 6 contains the number and prevalence for participants meeting the symptom case definition. Over 20% of the participants met the symptom case definition for the shoulder, elbow, and fingers, and more than 30% met the symptom case defi-nition for the neck and hand. Only 8% met the case definition for the back. Of respondents meeting the case definition, discomfort level was reported as moder-ate to severe in 35% to 50% of the cases. On average, upper extremity cases sought medical care two to three times; back cases sought care approximately five times. In addition, of the respondents who met the symptom case definition for hands (31) or fingers (29), 52% and 34%, respectively, reported being awakened at night by their pain, an indication of more severe conditions.

Logistic regression analysis was used to examine the relationship between the prevalence of symptom cases and work as a sign language interpreter. Regression models were constructed with (Table 7) and without controlling for age
and gender. Both models produced similar results, suggesting that neither age nor gender confounded the relationship in this group.

Symptom cases of the neck, fingers, and shoulders appeared to be associated with some aspect of work as a sign language interpreter. Statistically significantly elevated odds ratios were found for neck and finger symptoms in sign language interpreters who worked for 10 or more years relative to those working less than one year, and for shoulder symptoms in sign language interpreters who worked, on average, more than 20 hours per week. Odds ratios greater than one, with confidence intervals that do not include one, suggest a possible relationship between the symptom and the exposure, e.g., the number of years worked.

Table 8 contains the overall frequencies and prevalence of positive findings of the upper extremity as observed in the physical examination. Approximately 23% of the study participants were positive for findings in the hand/wrist area, and approximately 7% were positive in the elbow area. No subject was found to have finger abnormalities, or signs of thoracic outlet syndrome or bicipital tendinitis.

Prevalence rates for potential work-related upper extremity disorders meeting the definition for a symptom-exam case are described in Table 9. Of the 105 individuals included in the study, 95 had complete questionnaire and examination data on all the upper extremity areas of interest. Twelve of the 95 subjects (13%) had potentially work-related upper extremity musculoskeletal disorders. Nine percent of 97 participants with complete data for the hand/wrist area met the case definition for musculoskeletal disorders of the hand/wrist area, while 3% of 101 participants met the case definition for carpal tunnel syndrome. Less than 2% met the case definition for the neck, elbow, or shoulder, and no respondent met the case definition for finger abnormalities.

Of the nine individuals meeting the hand symptom-exam case definition, seven were female. The mean age of the nine subjects was 39, ranging from 28-56. The number of hours worked per week varied widely, having a mean of 16 and a standard deviation of 12. The same was true for the number of years worked, having a mean of 8 and a standard deviation of 5. Four of the nine used the ASL method, four used the transliteration (signed code for English) method, and one used both methods, equally. Two participants were primarily employed in educational institutions and two were employed in a public referral service. Three others were primarily self-employed, employed in a church, or by a private referral service. Two did not indicate a primary type of institution.

Because of the small number of symptom-exam cases, no further analyses were conducted on these data.

## VI. DISCUSSION

As an occupational group exposed to repetitive work activities, sign language interpreters are a unique study group. Although exposed to awkward and static postures, unlike many other workers who perform repetitive motions as a function of their jobs, sign language interpreters are not exposed to external loads, such as assembly parts or hand-held tools, and thus are exposed to only those forces generated by their body actions. This may partially explain why the prevalence rates for cases defined by both symptoms and physical findings were below 10% for every body part, and 3% or less for all but the hand/wrist area. However, this does not explain why over 90% of the sign language interpreters participating in this study reported having pain, discomfort, aching, numbing, tingling, or burning in the neck, shoulder, elbow, hand/wrist area, fingers, or low back within the year prior to the study. In the seven days prior to the study, at least 40% of the respondents (60% of those with symptoms in the past year) reported neck and hand/wrist pain, and over 20% (40% of those with symptoms in the past year) reported symptoms in the shoulders, fingers, and low back. With the exception of the low back, the site-specific symptom prevalence rate for work-related musculoskeletal disorders exceeded 20%. Cases of finger and neck symptoms appear to be related to the longevity as a sign language interpreter. Shoulder symptoms may be related to working over 20 hours per week during the past year of employment, but the data were not entirely consistent. This finding should be interpreted cautiously since the study is based on small numbers of individuals and self-reported estimates of the number of hours the participant worked each week as an interpreter. It is also possible that the results reflect the true nature of the relationship between number of hours worked per week and prevalence of symptom cases. That is, working more than 20 hours per week increases the interpreter's likelihood of experiencing shoulder symptoms.

To date, no controlled epidemiologic studies have evaluated the rate of work-related musculoskeletal disorders in sign language interpreters. However, a case report by Cohen (1990) suggested that at least 30% of 80 sign language interpreters who taught at a school for the deaf experienced periodic pain of the upper extremities. This rate is somewhat lower than the rates of symptoms observed in the sign language interpreters in this study (Table 4), but is similar to those of symptom cases (Table 6).

Symptom prevalence rates appear to be higher in sign language interpreters (Table 6) than reported in newspaper office workers who were studied using a similarly worded questionnaire. Among the newspaper staff the prevalence rates for the neck, shoulder, elbow, and hand/wrist area were 26%, 17%, 10%,

and 22%, respectively (Bernard et al., 1993). However, that study required moderate to severe discomfort as part of the case definition. Had we used that definition, the prevalence rates in our study would have been 50-60% lower, and thus, a bit lower than those in the newspaper staff.

Rates of musculoskeletal disorders, defined by the presence of a positive physical examination as well as symptoms, are considerably lower in sign language interpreters than those reported in telecommunication workers or supermarket cashiers. Among telecommunication workers, the overall prevalence of musculoskeletal disorders of the neck, shoulder, elbow, and hand/wrist areas were 9%, 6%, 7%, and 12%, respectively, based on the symptom-exam case definition (Hales et al., 1992). Prevalence rates based on symptom-exam cases were even higher among supermarket cashiers (neck - 16%; shoulder - 15%; elbow - 8%; hand - 29%) (Baron et al., 1991). CTS was observed in 11% of the 124 cashiers, but in only 3% of the sign language interpreters in this study.

It is puzzling that the prevalence of the symptom-exam cases is relatively low in this group of sign language interpreters given the overall high biomechanical demands of their jobs. In a separate study, a biomechanical analysis of the activity of sign language interpreting of a single individual reported repetition rates of 4.5 motions per second, frequent ulnar deviation or extension of the wrist in conjunction with extreme elbow flexion, and high accelerations of the wrist and hand (Shealy et al., 1992). Another study concluded that the rate of repetition and the velocity of the hands in sign language interpreting exceed levels observed in other occupational groups at high risk for upper extremity musculoskeletal disorders and that the continual exposure to such a high level of activity may put sign language interpreters at risk for developing work-related musculoskeletal disorders (Schoenmarklin and Marras, 1991).

A number of factors related to the limitations of the study design may have contributed to a possible misestimate of the prevalence of work-related musculoskeletal disorders in this population. First, this study used a cross-sectional design which included only those individuals who were employed as sign-language interpreters at the time of the study. Although the cross-sectional design permits examination of the association between health outcomes and some work factors, it is limited in its ability to assess a cause and effect relationship between sign language interpretating and the rate of work-related musculoskeletal disorders. Second, because we did not evaluate sign language interpreters who did not attend the conference and only 66% of the sign language interpreters attending the conference participated in the study, the results may not be representative of the experience of sign language interpreters as a whole. Third, the definitions for symptom cases and symptom-exam cases relied on the self-reports of symptoms over the past year and respondent's memory as to whether the symptoms occurred as a result of work

as a sign language interpreter. Because the study was conducted in response to a complaint of work-related pain, the work-relatedness of the symptoms may have been overstated by the respondents. Furthermore, individuals experiencing symptoms, may have been more eager to participate than those without symptoms. To try to minimize reporting bias, the symptom-exam case definition required a positive physical finding. The high rate of symptoms and more modest rate of symptom-exam cases, suggest that not all pain or other symptoms represent musculoskeletal disorders accompanied by positive physical findings. Finally, the study also may have misclassified the amount of interpreting because the study quantified only occupational exposure to sign language interpreting, but not other use of sign language, such as among family members or friends who are deaf.

## VII. CONCLUSIONS

This study suggests that cases of shoulder symptoms are associated with the number of hours that an individual interprets per week, and neck and finger symptoms are associated with length of employment as a sign language interpreter. Approximately 12% of the group had physical signs and symptoms consistent with musculoskeletal disorders of the upper extremities. It is important to interpret these data within the context of the limitations of this study. However, the data generated by the study are consistent with previous case reports of upper extremity symptoms in sign language interpreters and with biomechanical analysis of interpreting activities.

## VIII. RECOMMENDATIONS

1. A number of recommendations were suggested by Feuerstein and Fitzgerald (1992) in a study evaluating the actions of sign language interpreters with and without pain during the interpretation of the same text. These are summarized below.

    a. Include rest breaks in the interpreting session. Feuerstein observed that "...interpreters without pain introduced a greater number of rest cycles into the work." For example, when not using a hand for a sign, put it in a neutral posture or in a resting position.

    b. Reduce the rate of highly repetitive motions of the hands, wrists, and forearms. Feuerstein observed that interpreters without pain used a slower rate of signing compared to those with pain. However, the quality of the interpretation was not evaluated.

    c. Maintain signs within the optimal work envelope, that is, between the shoulders and within the area bounded by the chest and waist. Feuerstein observed that interpreters with pain "...frequently extend the

reach of the upper extremities..", to which he attributed to reports of pain and discomfort in the forearm and shoulder areas.

2. Other recommedations are given below:

   a. Avoid hitting hands together in a forceful manner. Because the sign, not the sound, is the communication device, forceful contact of the hand with any surface should be reduced.

   b. Prompt evaluations of employees with musculoskeletal disorders by a health care provider should be available without fear of employer reprisal. Review by the employee's primary physician may be helpful. Guidelines for health care providers to evaluate and treat these disorders have been published (Hales and Bertsche, 1992; Rempel et al., 1992).

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2. National Registry of Interpreters for the Deaf
3. OSHA, Region V, Chicago, Illinois

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TABLE 1
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Number (N) and Percent (%) of Conditions Reported by
Sign Language Interpreters

| **Condition** | **Total Respondents** | **N (%)** |
|---|---|---|
| Diabetes | 104 | 0 (0) |
| Gout | 104 | 0 (0) |
| Thyroid problems | 103 | 5 (5) |
| Disc problem in neck | 104 | 1 (1) |
| Disc problem in back | 104 | 1 (1) |
| Rheumatoid Arthritis | 101 | 0 (0) |
| Other Arthritis | 104 | 14 (14) |

TABLE 2
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Average Number of Hours Worked per Week
in the Past year

| Average number of hours worked per week in the past year | Number (%) |
|---|---|
| Less than 10 hrs | 39 (37) |
| 10-20 hrs | 38 (36) |
| $\geq$ 20 hrs | 29 (27) |
| Total | 106 (100) |

TABLE 3
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Methods most often used by Sign-Language Interpreters

| Method | Number | Percent |
|---|---|---|
| American Sign Language | 53 | 52 |
| Transliteration | 37 | 36 |
| Both | 12 | 12 |
| Total | 102 | 100 |

Table 4
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Number (N) and Prevalence (%) of Symptoms Reported in the Past Year and in the Past 7 Days by Sign Language Interpreters

| | Neck | Shoulder | Elbow | Hand | Finger | Back |
|---|---|---|---|---|---|---|
| | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
| Symptom in last year[5] | 68[1] (64) | 47[1] (44) | 38[2] (38) | 62[3] (59) | 47[4] (45) | 54[4] (52) |
| Symptom in Past 7 Days (%)[6] | 41 (60) | 24 (51) | 16 (42) | 40 (65) | 23 (49) | 28 (52) |
| Moderate to Severe Discomfort (%)[6] | 26 (38) | 15 (32) | 16 (42) | 27 (44) | 15 (32) | 22 (41) |

[1] Total responses = 106
[2] Total responses = 101
[3] Total responses = 105
[4] Total responses = 104
[5] Overall 92% of respondents reported symptoms of any site in the past year.
[6] Percent of those with symptoms in the past year

Table 5
HETA 92-0268
Characteristics of Sign Language Interpreters Reporting Symptoms in the Past Year

| | Neck | Shoulder | Elbow | Hand | Finger | Back |
|---|---|---|---|---|---|---|
| | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
| Total | 68 | 47 | 38 | 62 | 47 | 54 |
| % Symptoms due to interpreting | 38 (56) | 32 (68) | 26 (68) | 47 (76) | 31 (66) | 13 (24) |
| % Interpreters who saw health care providers | 31 (46) | 17 (36) | 17 (45) | 23 (37) | 18 (38) | 18 (33) |
| % Missed work | 8 (12) | 4 (9) | 3 (8) | 6 (10) | 2 (4 | 7 (13) |

Table 6
HETA 92-0268
Number and Prevalence (%) of Symptom Cases of Work-related
Musculoskeletal Disorders in Sign Language Interpreters

| | Neck | Shoulder | Elbow | Hand | Finger | Back |
|---|---|---|---|---|---|---|
| Total[1] | 84 | 92 | 91 | 89 | 100 | 78 |
| All Cases (%) | 31 (37) | 20 (22) | 24 (26) | 31 (35) | 29 (29) | 6 (8) |
| Cases with Moderate to Severe Symptoms (%)[2] | 11 (36) | 10 (50) | 11 (46) | 15 (48) | 11 (38) | 3 (50) |
| Times Sought Medical Care (SD) | 3 (4) | 3 (4) | 2 (3) | 2 (3) | 2 (4) | 5 (5) |

[1] Number of subjects with enough data to determine if they met the case definition
[2] Percent of cases

TABLE 7
HETA 92-0268
Odds Ratios (OR) and 95% Confidence Intervals (CI) for Adjusted[1]
Regression Analyses of Symptom Cases

| Location of Symptoms | Exposure | Comparison | OR | 95% CI |
|---|---|---|---|---|
| Neck | Years[2] | 10 yrs vs 0 yrs | 2.41 | 1.00, 5.83 |
| Finger | Years[2] | 10 yrs vs 0 yrs | 2.78 | 1.15, 6.73 |
| Shoulder | Hours\wk[3] | | | |
| | | 10-20 hrs vs <10 hrs | 0.37 | 0.09, 1.60 |
| | | >20 hrs vs <10 hrs | 2.52 | 0.77, 8.21 |
| | | >20 hrs vs 10-20 hrs | 6.81 | 1.61, 28.8 |

[1] Adjusted for age and sex
[2] Length of employment as a sign language interpreter in years
[3] Hours worked per week in past year (categories: (<) less than 10 hours, 10-20 hours, (>) greater than 20 hours)

TABLE 8
HETA 92-0268
Number (N) and Prevalence (%) of Selected Positive
Physical Examination Findings

| Physical Examination | Number[1] | Positive Examination (N) | Prevalence (%) |
|---|---|---|---|
| Any of the hand/wrist area | 102 | 23 | 23 |
| 30 second Phalen's Test | 104 | 7 | 7 |
| Phalen and Carpal Tinel Test[2] | 102 | 3 | 3 |
| Neck | 104 | 1 | 1 |
| Elbow | 104 | 7 | 7 |
| Findings defining rotator cuff tendinitis | 105 | 2 | 2 |
| Shoulder | 105 | 2 | 2 |

[1] Number of sign language interpreters with complete information on symptoms for that area and physical exam findings

[2] 30 second Phalen's Test

TABLE 9
HETA 92-0268
Prevalence of Potential Work-Related Upper Extremity Disorders
in Sign Language Interpreters (Symptom + Positive Examination)

| | Number[3] | Positive Physical Examination & Symptoms (N) | Prevalence (%) |
|---|---|---|---|
| Any Upper Extremity Disorder | 95 | 12 | 13 |
| Hand | 97 | 9 | 9 |
| Carpal Tunnel Syndrome[1] | 101 | 3 | 3 |
| Neck | 104 | 1 | 1 |
| Elbow | 103 | 2 | 2 |
| Shoulder[2] | 105 | 1 | 1 |

[1] Positive 30 Second Phalen's Test and Tinel's Test and awakened at night with pain
[2] This subject had rotator cuff tendinitis, defined as active or resisted arm abduction $\geq$ 90˚, plus deltoid palpation.
[3] Numbers vary due to missing questionnaire or exam data

**Appendix C**
**Physical Examination Criteria for Various Medical Conditions**
**HETA 92-268**

After performing each passive, active, and resisted maneuver, the examinee was asked to quantify the discomfort based on a five-point scale: 1=no pain, 2=mild pain, 3=moderate pain, 4=severe pain, and 5=the worst pain ever experienced. Maneuvers were considered positive if the discomfort score was ≥3.

**NECK**

| | |
|---|---|
| **Tension Neck Syndrome:** | Resisted flexion, extension, or rotation. |

**SHOULDER**

| | |
|---|---|
| **Rotator Cuff Tendinitis:** | Active or resisted arm abduction ≥ 90° or Deltoid Palpation. |
| **Bicipital Tendinitis**: | Positive Yergason's maneuver (DeGowin and DeGowin, 1983). |
| **Thoracic Outlet Syndrome:** | Positive hyperabduction and Adson's maneuvers. (Lister, 1984; Hoppenfeld, 1976) |

**ELBOW**

| | |
|---|---|
| **Epicondylitis**: | Medial or lateral epicondyle palpation, pronator teres, proximal resisted wrist or finger flexion, proximal resisted wrist or finger extension, or proximal resisted extension on the 3rd or 5th digit. |

**HAND/WRIST**

| | |
|---|---|
| **Tendinitis**: | Pain in the distal 2/3 of the forearm or hand on resisted wrist or finger flexion or extension. |
| **deQuervain's Syndrome**: | Positive Finkelstein's manuever (Finkelstein, 1930) |
| **Carpal Tunnel Syndrome:** | Positive Tinel's and Phalen's maneuvers. (Mossman and Blau, 1987; Phalen, 1966) |
| **Guyon Tunnel Syndrome:** | Positive Guyon Tinel's maneuver. (Pencina et al, 1991) |
| **Ganglion cysts:** | Presence of ganglion cysts. |
| **Joint-related abnormality**: | Decreased MCP, or PIP range of motion (< 100°) |

| | |
|---|---|
| **Trigger Finger:** | Locking of finger in flexion or palpable tendon sheath ganglion. (Labidus, 1953). |
| **Hand/wrist abnormality:** | Guyon Tunnel or deQuervains's Syndrome, trigger finger, ganglion cysts, tendonitis, distal resisted extension on 3rd or 5th digit, or joint related abnormality |

**FINGER**

| | |
|---|---|
| **Range of Motion:** | Abnormal range of motion of PIP for 2nd, 3rd, 4th, or 5th digit. |