

THE PREVALENCE OF MUSCULOSKELETAL DISORDERS AND RELATED WORK AND PERSONAL FACTORS AMONG DIAGNOSTIC MEDICAL SONOGRAPHERS

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ABSTRACT

Work-related musculoskeletal disorders are a group of syndromes characterized by soft tissue discomfort caused or aggravated by workplace exposures. Previous research has shown an increasing concern over musculoskeletal symptomology among diagnostic medical sonographers. The purpose of this study was to describe the prevalence of musculoskeletal disorders and related work and personal factors among diagnostic medical sonographers. Data were gathered through a survey distributed to randomly selected members of the professional sonographer registry in the United States. Eighty-one percent reported musculoskeletal pain or discomfort which they associated with the work tasks of scanning. The neck, shoulder, wrist, hand/fingers and back were the sites where pain was most often reported, and the specific activities of manipulating the transducer while sustaining applied pressure, shoulder abduction and sustained twisting of the neck/trunk were seen to be the key activities which aggravated the pain and discomfort. Among those reporting pain and discomfort, a very small minority were absent from work. The remainder reported working in pain. Respondents indicated increased work periods without rest breaks, and an inability to control work flow in order to take breaks. However, they indicated general satisfaction with their work environment and corporate culture. Further analyses are required to investigate the strength of relationship between musculoskeletal disorders, work and personal factors.

INTRODUCTION

Work-related musculoskeletal disorders are a group of syndromes characterized by soft tissue discomfort caused or aggravated by workplace exposures¹. These disorders include tendinitis, tenosynovitis, and neuropathy resulting from nerve entrapment or occlusion of the blood supply. They have been reported in a variety of occupations and are associated with static activity, particularly where low levels of muscle force or static postures are required for prolonged periods or where awkward postures are required. Many of these disorders have been brought about by technological advancements in the work

environment requiring increased use of computerized equipment².

The advent of new technology in diagnostic medical sonography has resulted in increases in the number of sonograms performed and the duration of each patient session³. Sonographers perform prolonged sitting and/or standing, lifting and positioning patients, and other tasks which are physically demanding and awkward. Sonography requires static and dynamic loading of the muscles of the neck, shoulder, arm and back, as well as sustained fine motor movements of the shoulder, forearm, wrist, hand and fingers as the sonographer manipulates the transducer against the patient.

While sonography has been shown to be related to the types of musculoskeletal disorders described², the issue is complicated by a variety of factors that may contribute to musculoskeletal injury. These include: age, gender, posture, health status, lifestyle behaviors, ergonomic design, work load, and physical activity, among others⁴⁻⁷. While musculoskeletal disorders have been recognized among medical sonographers^{2,8-10}, much is yet to be learned about the prevalence of specific disorders, contributing factors and prevention strategies. The purpose of this study was to describe the prevalence of musculoskeletal disorders and related work and personal factors among diagnostic medical sonographers. Data were gathered through a survey distributed to randomly selected members of the professional sonographer registry in the United States.

This report represents preliminary information which is part of a larger, more comprehensive investigation that examines musculoskeletal disorders among diagnostic medical sonographers throughout Canada and the United States. The purposes of the investigation are to: (1) determine the prevalence of musculoskeletal disorders among diagnostic medical sonographers and correlate known work and personal factors with the reported musculoskeletal disorders, (2) develop the recording instruments, protocols and methods of data analysis needed to quantify the risks of musculoskeletal disorders among sonographers, (3) design interventions to reduce a given risk for musculoskeletal disorders, (4) make any necessary recommendations regarding the need for modification or redesign of sonography equipment and/or work environment,

(5) make any necessary recommendations regarding the work load and procedural techniques of sonography.

METHODS

Survey Design and Distribution

A pilot survey was developed following a review of the literature, personal interviews with experienced sonographers and input from professional sonographer societies and associations. Ten pilot surveys were distributed to practicing professional sonographers and no major problems with the instrument were found. The survey consisted of 125 questions divided into five sections: (A) Work experience, general health and background information, (B) Work schedule and work tasks, (C) Work equipment, (D) Problems, pain and discomfort, and (E) Work environment and corporate culture. Three thousand surveys were distributed to participants who were randomly selected from the national membership directory of the American Registry of Diagnostic Medical Sonographers (ARDMS).

The work experience, general health and background information section of the survey consisted of questions pertaining to current position and employer, years scanning, experience with different types of scanning, age, gender, height, weight, smoking status, use of upper extremity splints or braces, use of corrective lenses, current health status, fitness and leisure time physical activities. Physical activity was defined as the number of days per week the respondent took part in leisure time activities at a moderate pace for at least 20 minutes continuously (e.g. walking, running, cycling, swimming, etc.).

Questions pertaining to work schedule and tasks included average number of days scanning per month, average hours scanning per day, average hours per day worked, time sitting, standing, instructing, breaks, type of scans performed per week, proportion of scans with either hand, time maintaining one body position and time spent using computer keyboard in addition to scanning work. Work equipment questions asked about machines used, preferred machines, characteristics of machines and related equipment, transducers used and education and use of ergonomics in workstation set up.

The problems, pain and discomfort section asked participants to indicate any work-related pain or discomfort, the severity, frequency and time of day for: eyes, neck, upper back, middle back, lower back, hip, upper leg, knee, lower leg, ankle/foot, shoulder, upper arm, forearm, wrist and hand/fingers. Participants were asked to describe their pain, the work activities that were aggravating to the pain or discomfort, how long they had experienced pain or discomfort, whether they still had the problem, whether they had seen a medical professional, received a diagnosis, received treatment, efficacy of treatment, results of work-related problem, the use of Workers' Compensation and other benefits programs, whether the problem was resolved, what resolved the problem and whether the participant had received education about work-related injury and prevention.

The work environment and corporate culture section asked participants to indicate their degree of agreement (1 = strongly disagree to 5 = strongly agree) to 43 statements in 8 sections:

(1) physical support, (2) co-worker support, (3) supervisor support, (4) senior management support, (5) work schedule, (6) work tasks, (7) work clarity and (8) support services. The statements are based on previous work by Insel and Moos (Work Environment Scale)¹¹.

Data Analysis

Responses to the survey were analyzed using SPSS (SPSS Inc., Chicago, Ill). Descriptive statistics were used to show frequency distributions, percentages, mean, median, standard deviation and range for all responses. The analysis in this study was confined to descriptive information on a subset of survey questions. These items were selected by directors of SDMS with the intent of generating an overview of musculoskeletal disorders and related factors among sonographers prior to conducting more detailed analyses.

RESULTS

Of the 3,000 surveys distributed, a total of 983 respondents was achieved. This represents a moderate response rate of 32.8%, but nearly all of the projected 1,000 responses required to make generalizations to the population of sonographers in the United States. Eighty-five percent of respondents were female. Forty percent were in their 30s and another 40% were in their 40s. Sixty-five percent were staff sonographers, while 14% were administrator, chief or lead sonographers. Of the 21% who reported both functions, the average time spent as an administrator, chief or lead sonographer was 34%. The mean number of years scanning was 10.9 ± 5.7 . Fifty-three percent were employed by a hospital, 22% by a private clinic, 12% by both a hospital and clinic, and 12% by various other employers.

The mean height and weight of all respondents was 65.6 ± 4.4 in. and 149.6 ± 32.6 lb., with a calculated Body Mass Index of 24.4. Seventy percent reported never having smoked and 20% said they were former smokers. Ninety-six percent of the sonographers rated their current health status as good or excellent. Yet, 25% reported high blood pressure, 28% reported arthritis and 41% reported other upper extremity joint or bone disorder. Ten percent reported using an upper extremity brace or splint.

Almost three-quarters of the respondents rated their current fitness level as either good or excellent, and almost 45% reported being physically active at least 3 times per week. An additional 28% reported physical activity once or twice per week. For the remainder, the leading reasons for not engaging in physical activity on a regular basis were lack of time (83%), lack of energy (40%) and lack of interest (24%). Compared to their average activity level over the past five years, 60% of respondents reported that their current activity was about the same or higher, with about one-third reporting that they regularly performed exercises for the back, neck, shoulder and arms.

Table 1 provides descriptive information regarding the average time scanning for both normal work hours and on-call hours. The average work day was 8.3 ± 1.4 hours and the average number of hours per work day spent scanning was 6.8 ± 2.0 . This implies an average of approximately 1.5 hours per day for the performance of any other related duties, rest breaks

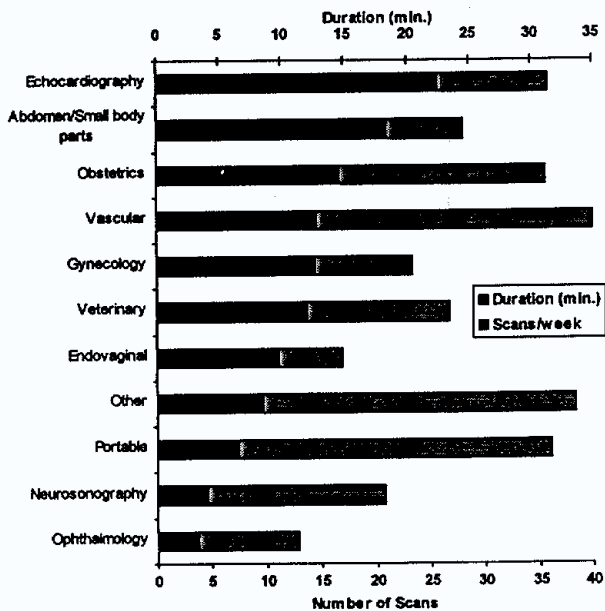
and meal breaks. When asked about breaks, 61% reported that during a typical work day they took none or one break of ten minutes or longer; 32% reported taking 2 or 3 breaks of 10 minutes or longer per day, while 7% said they were able to take 4 or more breaks per day. Sixty-two percent reported that they worked continuously for 3 or more hours between breaks. Twenty-six percent worked for 1 to 3 hours between breaks, and 12% said they were able to take a break after each hour of work.

Table 1. Scanning Work Schedules (n=970)

	Mean	S.D.	Median
Days/month scanning	17.8	5.4	20.0
Hr/day scanning	6.8	2.0	7.0
Days/month <i>On Call</i> scanning	3.9	4.9	2.0
Hr/month <i>On Call</i> scanning	8.0	15.8	3.0
Average work day (hr)	8.3	1.4	8.0
Percent time scanning in sitting position	57.0	35.8	65.0

Figure 1 illustrates the average duration and number of scans performed per week. The most frequently reported type of scan was echocardiography, with sonographers performing approximately 22.5 ± 16.0 echocardiograms per week at an average duration of approximately 35.9 ± 14.7 min., though both the number and duration were somewhat variable. Vascular scans were reported to take the longest time to perform, with an average of 40 ± 18.3 min.; again this was somewhat variable. Neurosonography and ophthalmology scans were performed relatively infrequently.

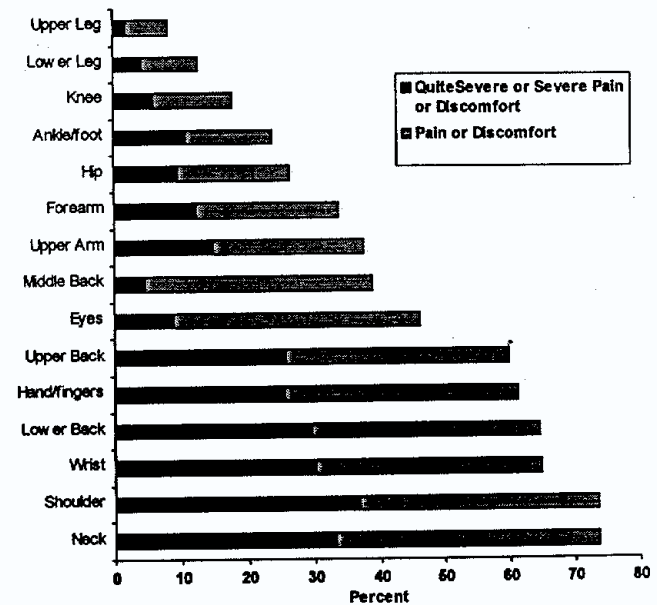
Figure 1. Average Number and Duration of Scans per Week (n=970)



Eighty-one percent of all respondents reported that they had experienced pain and discomfort since starting work as a sonographer. Of those, 97% thought that the pain and discomfort were related to the work of scanning. Ninety-one percent reported that they were still experiencing pain and discomfort, and that the average period of time they had had the pain and discomfort was in excess of five years (mean = 62.4 ± 51.4 months; median = 48 months).

Figure 2 illustrates both the anatomical site of pain and discomfort and the proportion who indicated that the pain or discomfort was quite severe or severe, for the 81% of sonographers who reported pain and discomfort. The neck, shoulders, wrist, hand/fingers and back were the sites where pain and discomfort was most often reported. The highest proportion of sonographers reported the same sites as giving them the most severe pain. When asked to choose from a list of words that described the pain and discomfort, 90% reported an aching feeling, 56% said they experienced stiffness, approximately 40% said they had sharp pain or cramping, and about one-third experienced weakness, numbness or burning. The percentages exceed 100% as many sonographers reported multiple words to describe their pain.

Figure 2. Reported Pain and Discomfort by Anatomical Site (n=793)



Sonographers were asked to indicate by means of a five-point rating scale (1 = not aggravating to 5 = very aggravating), which of their work tasks they find aggravating to their pain or discomfort. Figure 3 illustrates that, on average, applying pressure, shoulder abduction and sustained twisting of the neck/trunk were the activities that were reported as most aggravating to their pain and discomfort. The majority of activities, in and of themselves, were not reported as particularly aggravating to existing pain and discomfort.

Of the respondents who reported pain or discomfort, 52% had seen a physician or other medical professional about the

problem. Of these, 89% received a diagnosis for the problem, but only 43% received any kind of treatment for the problem. Table 2 indicates the diagnoses provided by the physician or other medical professional. The largest proportion of respondents chose the "other" category from among a list of 13 possible diagnoses. The majority of respondents who received treatment were given medications (64%). Physiotherapy (42%), chiropractic (33%) and massage therapy (30%) were also prescribed, with many respondents receiving more than one treatment modality. Approximately one-third reported receiving "other" treatments for their pain or discomfort. Sixty-seven percent reported that the treatment had been moderately or very effective in dealing with the problem. Twenty-eight percent said the treatment had been slightly effective, and 4% reported no treatment effect.

Table 2. Medical Diagnosis of Problem Related to Scanning (n = 273)

Diagnosis	n	Percent
Other	101	37.0
Tendinitis	77	28.2
Musculoskeletal Injury	49	17.9
Tension Neck Syndrome	45	16.5
Carpal Tunnel Syndrome	44	16.1
Bursitis	22	8.1
Myalgiamyositis	10	3.7
Cervical Syndrome	9	3.3
Ganglions	7	2.6
Thoracic Outlet Syndrome	6	2.2
Tenosynovitis	3	1.1
Cubital Tunnel Syndrome	3	1.1
Epicondylitis	1	0.4

Figure 4 illustrates the consequences of scanning-related pain or discomfort; many respondents reported multiple consequences. The majority of respondents reported experiencing pain in the performance of their work duties (84%). Pain was also reported in the performance of home activities (60%) and recreational activities (52%). A smaller proportion reported a decreased ability to perform home activities (36%), recreational activities (36%) and regular job duties (22%). Only 10% reported being absent from work as a consequence of pain or discomfort. The mean number of days absent was 19.1 ± 26.3 , with a median value of 7.0 days.

Table 3 indicates the sonographers' perceptions of their work environment and corporate culture. Mean values were calculated for each of the eight sections. Mean values for each section ranged between 3.0 and 3.8 indicating in general, a neutral or positive perception of their work environment and corporate culture. When all 43 individual items were reviewed, 6 showed mean score values less than 3. Three of these related to the work schedule section, two to the support services section and one to the work tasks section (Table 4).

Figure 3. Scanning-related Activities which Aggravate Pain and Discomfort (n=793)

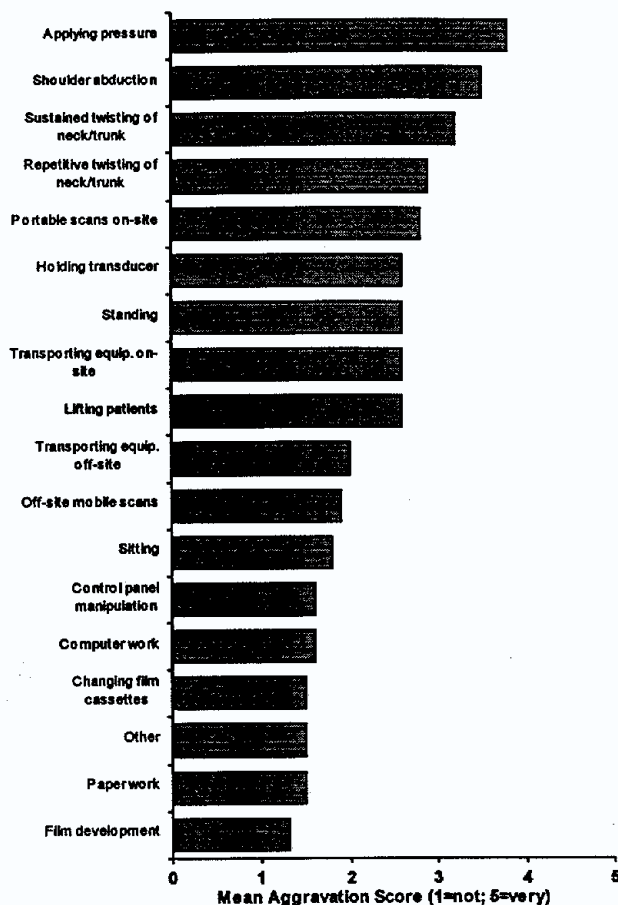
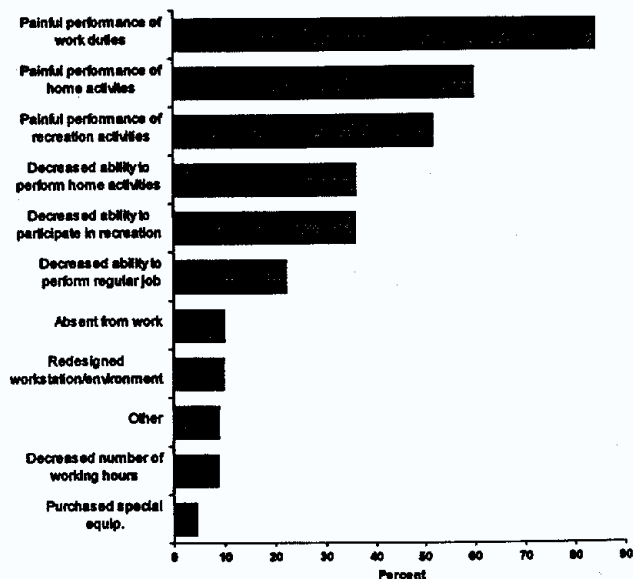


Figure 4. Consequences of Scanning-related Pain or Discomfort (n=653)



Eighty-two percent reported taking fewer than three breaks of ten minutes or more per day, which may place them at higher risk for developing and/or aggravating musculoskeletal disorders. The majority of respondents reported an inability to control day-to-day workload, plan overtime or extra work in advance, or to take scheduled breaks during the work day. Karasek¹⁶ has discussed the effects of reduced job control and decision latitude as precursors to increased work stress which can lead to physical symptoms. The perceived high job demand (high duration of work period without breaks) and the reduced job control (inability to control workload, plan, or take scheduled breaks) may be contributing factors to pain, discomfort and musculoskeletal disorder among the current respondents. On a positive note, however, sonographers reported that they performed the majority of their scanning work in a seated position (mean 57%; median 65%) which, according to Craig⁹, leads to decreased symptoms of musculoskeletal disorders.

The prevalence rates of pain, discomfort and musculoskeletal problems were self-reported and not based on clinical evidence. The reported levels, while high, are in agreement with previous research conducted on sonographers^{2,10} and in other work environments where repetitive motions are required on a sustained basis with static and dynamic loading of the neck, back, shoulders and upper limbs^{15,17}. It should be noted that pain and discomfort in the neck, and back (lower back and upper back) constituted a large proportion (60%-75%) of the reported problem areas. Given that back pain is one of the major health problems among workers in industrialized nations, affecting 80% to 90% of the populace at some time during their lives, it is reasonable to expect that sonographers in the current study would report higher levels of back pain.

In addition to the reported back pain, a majority of respondents reported pain and discomfort in the shoulder (74%), wrist (65%), and hand/fingers (61%) which they saw as directly related to the work of scanning. In particular, applying sustained pressure with the transducer, sustained shoulder abduction and sustained twisting of the neck/trunk were viewed as the most aggravating activities. Previous research has shown that the application of sustained force leads to the increased likelihood of developing musculoskeletal injuries^{18,19}. Among sonographers, Vanderpool² has demonstrated a significant positive correlation between high hand grip pressure and symptoms of carpal tunnel syndrome (CTS). Medium and low hand grip pressure were negatively correlated, and twisting and pushing motions in the wrist correlated positively with symptoms of CTS, but failed to achieve significance at the $p \leq 0.05$.

Musculoskeletal injuries and the associated time loss, decreased productivity and increased medical expenses represent a substantial increasing cost to industry and society in general. By one estimate, 24% of sick time usage is due to pain in the back, neck and shoulder²⁰. As a percent of payroll, medical care cost increased from 4.6% in 1980²¹, to 13.5% in 1989²². Perhaps the most startling fact from the corporate perspective is that as a percent of after-tax profits, medical care

expenditures have grown from approximately 14% in 1965 to 86% in 1988; in 1986 they equaled 110%²³.

While the large majority of the sonographers in the current study reported pain and discomfort, only a small proportion (10%) reported being absent from work as a consequence of the problem or reduced their working hours (8%). The majority continued to attend scheduled hours of work but reported working in pain (84%) and a decreased ability to perform regular work duties (22%), both of which impact productivity and future costs, both to the organization and individual. This situation may be explained by a variety of factors, including necessity to earn a wage, feelings of professional obligation, love of the work, increased satisfaction with the work environment. Indeed, with the minor exception of concerns of control over work scheduling, the current respondents indicated a more positive rating of their work environment and corporate culture.

CONCLUSION

The current investigation describes the prevalence of musculoskeletal disorders and related work and personal factors among a representative random sample of diagnostic medical sonographers in the United States. Consistent with previous research, the prevalence of musculoskeletal disorders, and the perception that the disorder is related to the work of scanning, is high among the current respondents. Further, the specific activities of manipulating the transducer while sustaining applied pressure, shoulder abduction and sustained twisting of the neck/trunk, which have been previously correlated with musculoskeletal disorder, were seen to be the key activities which aggravated the pain and discomfort.

While the current respondents indicated increased work periods without rest breaks, and an inability to control work flow in order to take breaks, they also indicated general satisfaction with their work environment and corporate culture. Among the large majority reporting pain and discomfort, a very small minority were absent from work. The remainder reported working in pain.

The descriptive nature of the current investigation must be emphasized. Further analyses are required to investigate the strength of relationship between musculoskeletal disorders, work and personal factors. Following these analyses it may then be possible to make recommendations regarding possible modification or redesign of sonography equipment and the work environment, as well as the work load and procedural techniques.

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