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Abstract

The purpose of this study was to provide a profile of work-related injuries among diagnostic sonographers. One hundred and fifty-six of the estimated total of 180 sonographers living in Alberta were surveyed by mail. Of the 96 (61.5%) respondents, 85 (88.5%) reported work-related symptoms. Significant differences in gender, age, height, weight and body mass index (BMI) were found between groups of sonographers with, and those without work-related injuries ($p \leq 0.05$). Three clusters of symptoms emerged from the data: (a) neck and interscapular pain, (b) shoulder or upper arm pain, elbow pain, hand/wrist pain, clumsiness of the fingers and numbness or tingling, and (c) frontal headaches and visual disturbances. Significant relationships were found between cluster 1 and sustained shoulder abduction, sustained twisting of the neck and trunk, repetitive twisting of the neck and trunk, and clerical activities ($p \leq 0.05$). Increased workload/decreased staff, sustained posture or activity and equipment design were identified as factors which could result in an increase in work-related injuries among sonographers.

Relevance to industry

Ultrasonography is an essential health care diagnostic service. However, the activities performed by ultrasound technicians are resulting in work-related injuries. This study, as well as future studies, will help identify and minimize risk factors, thereby helping prevent work-related injuries among sonographers and other health care workers.

Keywords: Sonographers; Ultrasound; Repetitive strain injury

1. Introduction

Diagnostic medical sonography is a relatively new profession, coming into existence in the early 1940's (Craig, 1993). The advent of new technologies and the recognition of the diagnostic capabilities of ultrasound have resulted in an increased number and duration of sonograms performed each year (Vanderpool et al., 1993). Sonographers perform prolonged sitting or standing, lifting and positioning patients and other tasks which are physically demanding (Craig, 1993). They are required to work in darkened noisy environments and are exposed to

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processing and cleaning chemicals, biohazardous materials and video monitors. For up to 90 min at one time with a transducer in the hand, a sonographer must apply pressure to keep the transducer in contact with the patient's body. The sonographer may keep the transducer relatively still or may move it in repeated arcs over the area of the body being investigated. In order to support and fix the arm in a position to hold the transducer against the patient, static or sustained isometric contraction of the neck, back, shoulder and upper extremity is necessary (Vanderpool et al., 1993). The shoulder is held in an abducted position for prolonged periods especially when the sonographer is scanning with the right hand. Chaffin (1973) indicated that greater than 30 degrees of abduction results in a rapid increase in fatigue rate of the medial portion of the deltoid muscle and thus, reduced physiological efficiency. To manipulate the transducer repetitive movements of the shoulder, forearm, wrist, hand and fingers are required (Vanderpool et al., 1993). Repetitive motion of the hand can lead to injury especially if tools must be grasped (Hymovich and Lindholm, 1966). Johnson (1993) indicated that poor tool design can stress the small muscles of the hand resulting in fatigue and inefficient use of energy for tool manipulation.

Visual disturbances such as eyestrain, eye irritation, blurred vision and difficulty focusing are reported by sonographers (Craig, 1990). Improper lighting and glare appear to be the most common factors associated with visual disturbances reported by sonographers.

In a study by Vanderpool et al. (1993) of carpal tunnel syndrome and other musculoskeletal problems in cardiac sonographers, 86% reported symptoms of work-related musculoskeletal injuries. Sixty-three percent of those who completed the survey indicated that they had at least one or more symptoms of carpal tunnel syndrome. As a result of work-related symptoms, 17% missed work, 31% indicated that they had received treatment of injuries and 4% indicated that they received workers' compensation benefits.

The primary objective of this study was to determine the profile of work-related injuries among sonographers in general. This study differs from the study by Vanderpool et al. (1993) in which the work-related injuries specifically of cardiac sonographers were addressed. Questions related to work-related injuries among sonographers in general have not been addressed in any other studies reported.

This study was designed to elicit information about: (1) the differences and similarities among personal and professional characteristics of those with, and those without work-related symptoms, (2) consequences of work-related injuries among sonographers and (3) possible risk factors which sonographers perceive may contribute to work-related injuries among sonographers in general.

2. Methods

A questionnaire was developed following exploratory interviews with sonographers and a review of the literature. This questionnaire was pretested in a pilot study for its clarity, length and acceptability by 6 sonographers and appropriate adjustments were made. One hundred and fifty-six sonographers practicing in Alberta were surveyed using this questionnaire (Appendix A).

The questionnaire consisted of a series of 27 questions. The initial 14 questions dealt with demographic information: gender, age, height, weight, place of employment (hospital, private clinic or other), province or territory in which training occurred, use and types of corrective lenses, frequency of exercise, present activity level compared to average activity level during the past five years, scanning hand (right, left or both), length of time since completion of training, and full-time versus part-time hours of work. In two questions, sonographers were asked to identify prevalence of work-related injury and specific symptoms which sonographers believed were a direct result of their work activities. Sonographers were asked to indicate if they had ever been diagnosed by a physician as having carpal tunnel syndrome, tendinitis, tenosynovitis, epicondylitis, bursitis, ganglions or other diagnoses. Three questions pertaining to consequences of work-related injury included absenteeism from work, decreased number of working hours, decreased ability to perform regular job duties, utilization of services (sick leave, unemployment insurance, vacation leave, treatment, medications and workers' compensation) and changes made as a result of work-related injury

(job duties, equipment, layout of work station, lighting). Information was elicited concerning education and sources of education regarding work-related injury, job satisfaction, and the single most important factor which could result in an increase in work-related injuries over the next 3 to 5 years. Sonographers were asked to indicate the level of involvement in activities that sonographers performed during the course of a typical work day, and the degree to which sonographers perceived each activity contributed to work-related injury for sonographers in general.

3. Data analysis

The responses were analyzed using the SPSS for Windows release 6.1 program on an IBM clone DX computer. Frequency distributions were calculated on each item of the questionnaire to determine the characteristics of the sample of sonographers. Descriptive statistics were computed to determine the demographic profile of the subjects.

Crosstabulations and Pearson's correlations of the demographic variables with prevalence of work-related symptoms, specific work-related symptoms, specific diagnoses and resolution of symptoms were computed. For each work-related activity performed by sonographers, crosstabulations and correlations of level of involvement and degree to which each activity contributed to work-related symptoms with specific work-related symptoms and diagnoses by a physician were performed to identify clusters. Pearson's correlations between level of involvement and contribution to injury for each job activity were also performed.

For the open-ended questions the responses were grouped according to categories which emerged from the data, and frequencies were determined for each category.

4. Results

The sample consisted of 96 out of 156 diagnostic medical sonographers who were surveyed: 83 (86.5%) females and 13 (13.5%) males. This sample was further divided into two subgroups: those with work-related symptoms and those without work-related symptoms. Eighty-five respondents (88.5%) reported that they either had experienced, or were currently experiencing work-related symptoms. A positive correlation of 0.43 $p \leq 0.05$) was found between gender and work-related symptoms. Proportionally more women than men had experienced work-related symptoms.

A negative correlation ($r = -0.22$; $p \leq 0.05$) was found between work-related symptoms and age. Sonographers with work-related symptoms were slightly younger than those without work-related symptoms. Negative correlations were also found between work-related symptoms and height ($r = -0.24$; $p \leq 0.05$) and weight ($r = -0.34$; $p \leq 0.05$). Respondents with work-related symptoms were slightly shorter than those without work-related symptoms. Those with work-related symptoms were slightly lighter in weight than those without work-related symptoms.

Fifty-five (57.3%) sonographers were employed in a hospital, and of these sonographers, 50 (91%) had work-related symptoms. Thirty-seven (38.5%) were employed in a private clinic and 31 (83.3%) had work-related symptoms. Of the remaining four respondents, 3 worked in both a hospital and private clinic, and 1 worked in a mobile unit. All four respondents had work-related symptoms.

The majority of respondents (88.5%) scanned with their right hand. Of these respondents, 76 (89.4%) had work-related symptoms. Of the two individuals who scanned with their left hand, one had work-related symptoms. Of the 9 sonographers who used both hands for scanning, 8 had work-related symptoms.

The majority of respondents were either satisfied (47.9%) or extremely satisfied (37.5%) with their jobs. However, all sonographers who were dissatisfied with their jobs (11%) had work-related symptoms. A negative correlation was found between work-related symptoms and job satisfaction ($r = -0.21$; $p \leq 0.05$).

Eighty-five respondents (88.5%) reported work-related symptoms. The work-related symptoms reported by sonographers are listed in Table 1. A positive correlation was found between present activity level (as compared to average activity level of the past 5 years) and presence of neck pain ($r = 0.38$;

Table 1
Work-related symptoms experienced by sonographers

Work-related symptom	Respondents with work-related symptom ($n = 85$)	
	(#)	(%)
Pain between shoulder blades	46	54.1
Shoulder or upper arm pain	45	52.9
Neck pain	41	48.2
Low back pain	32	37.6
Hand or wrist pain	32	37.6
Redness/dryness of eyes	29	34.1
Numbness or tingling of fingers	24	28.2
Elbow pain	20	23.5
Frontal headaches	16	18.8
Blurring of vision	11	12.9
Pulling of the eyes	10	11.8
Clumsiness of fingers	10	11.8
Other symptoms	6	7.0

Table 2
Diagnoses of work-related injuries sustained by sonographers

Diagnosis	Respondents with diagnosis ($n = 35$)	
	(#)	(%)
Tendinitis	16	45.7
Epicondylitis	9	25.7
Bursitis	9	25.7
Other	9	25.7
Ganglions	6	17.1
Carpal tunnel syndrome	5	14.3
Tenosynovitis	3	8.5

Table 3
Pearson's correlations comparing demographic variables with diagnoses ($p \leq 0.05$)

Demographic variable	Diagnoses			
	tendinitis	bursitis	ganglions	epicondylitis
Age			0.21	
Gender				
BMI	0.25			
Scan hand			0.34	
Av. years full time work	0.27	0.25		0.21

$p \leq 0.05$), and between years since completion of training and shoulder/upper arm pain ($r = 0.31$; $p \leq 0.05$).

Of the 85 individuals who had work-related symptoms, 35 indicated they had received a diagnosis by a physician. The diagnoses are reported in Table 2. The most common diagnosis of work-related injury was tendinitis (45.7%). Significant correlations were found between several of the demographic variables and diagnoses (Table 3).

Sonographers recorded the level of involvement (1 = no involvement, 2,3,4,5 = considerable involvement) and their perception of the degree of contribution to injury (1 = no contribution to injury, 2,3,4,5 = very high contribution to injury) for work-related activities specific to their profession. In Table 4 the mean values for level of involvement and contribution to injury are presented.

Table 4
Mean scores for level of involvement and contribution of activity to injury

Activity	Level of involvement		Contribution to injury	
	(score)	(# of responses)	(score)	(# of responses)
Gripping transducer	4.7	94	3.4	88
Applying sustained pressure with transducer	3.8	94	3.9	92
Sustained twisting of neck and trunk	3.7	93	3.9	91
Sustained shoulder abduction	3.5	93	4.0	89
Repetitive twisting of neck and trunk to look from patient to monitor	3.5	91	3.6	88
Prolonged sitting	3.0	93	2.4	87
Prolonged standing	2.9	94	2.8	91
Changing cassettes	2.9	94	2.1	91
Lifting/assisting patients	2.7	94	3.2	92
Clerical work	2.4	94	1.4	91
Performing mobile studies	2.0	93	2.8	90
Transporting equipment for mobile studies	2.0	94	2.6	90

With the exception of gripping the transducer all correlations between level of involvement and contribution to injury for each variable were significant at $p = \leq 0.05$. The top 3 activities in which the level of involvement and contribution to injury were most strongly correlated were sustained twisting of the neck and trunk ($r = 0.59$), performing mobile studies ($r = 0.57$) and repetitive twisting of the neck and trunk ($r = 0.53$).

Of the 85 individuals with work-related symptoms, 24 (28.2%) indicated that their symptoms had resolved, 36 (42.4%) indicated that their symptoms had not resolved and 25 (26%) did not respond. The two major interventions which helped reduce or eliminate work-related symptoms were treatment (physical therapy, chiropractic care, massage, etc.) and adjustment of the worksite. Due to the number of missing responses, no further analyses or interpretation were performed.

In an effort to determine if some of the symptoms tended to be grouped together, the correlations were examined and an 'inside out' table was developed. Correlations greater than 0.30 ($p \leq 0.05$) were included in the table. The symptoms which tended to be correlated with one another were grouped or clustered together. Three distinct clusters were found. The symptoms of neck pain and shoulder blade (interscapular) pain were positively correlated ($r = 0.48$; $p \leq 0.05$) and formed cluster 1. Many relationships were found between symptoms of shoulder and upper arm pain, elbow pain, hand and wrist pain, numbness or tingling, and clumsiness of the fingers, so they were grouped together to form cluster 2. Relationships were found between the symptoms of frontal headaches, pulling sensation of the eyes, blurring of vision, and redness or dryness of the eyes, therefore, this group of symptoms formed cluster 3. Only those respondents that had all of the symptoms in a cluster were included within that cluster. Examinations of the clusters revealed that there were 31 respondents with neck and interscapular pain in cluster 1. Cluster 2 contained 4 respondents with all the associated symptoms. Since cluster 3 contained only one respondent, no further analyses of cluster 3 were carried out.

Crosstabulations and correlations of clusters 1 and 2 with each of the demographic variables, level of involvement in activities, and contribution to injury were performed. No significant correlations were found between the demographic variables and cluster 1. A positive correlation of 0.23 ($p \leq 0.05$) was found between cluster 2 and BMI. This suggests that those respondents with all symptoms in cluster 2 have a higher body mass index. All 4 respondents in cluster 2 were outside the healthy range for BMI. Of these 4 individuals, 3 were above the upper healthy range limit. No significant correlations were found between cluster 2 and levels of involvement or contribution to injury.

Table 5
Pearson's correlations between cluster 1 (neck and shoulder blade problems) and levels of involvement and contribution to injury ($p \leq 0.05$)

Work-related activity	Correlation	
	level of involvement	contribution to injury
Sustained shoulder abduction	0.28	0.28
Sustained twisting of neck and trunk	0.36	0.35
Repetitive twisting of neck and trunk		0.24
Clerical work	−0.22	

Significant relationships were found between cluster 1 and several of the levels of involvement and contribution to injury variables. These are presented in Table 5.

Sonographers were asked to indicate the number of days absent from work due to work-related injury (based on a $7\frac{3}{4}$ h work day). Sixteen respondents (16.7%) reported they had been absent from work due to work-related symptoms. Excluding two outliers (150 and 225 days), the average number of days of absence from work was 15.3 days. Nine respondents (9.4%) indicated they had decreased their work hours as a consequence of their work-related injury. Fourteen sonographers (14.6%) reported decreased ability to perform their regular job duties.

Eighteen (21.2%) of the 85 respondents with work-related symptoms utilized sick leave, 1 utilized unemployment insurance, 10 took vacation leave, 1 utilized disability insurance and 11 received workers' compensation benefits. Thirty-seven respondents received treatment (physical therapy, chiropractic care, massage, etc.) for work-related symptoms and 27 took medications. Two individuals resorted to regular exercise as a result of their work-related injury.

Table 6
Factors which could result in an increase in work-related injuries in diagnostic sonographers over the next 3 to 5 years

Factor	Responses (#)	Percentage (%)
Increased workload/decreased staff	35	41.2
Sustained posture/activity	21	24.7
Equipment	10	11.8
Mental stress	4	4.7
No knowledge/no change of activity	3	3.5
Job tasks	2	2.4
Patient type or size	2	2.4
Increased performance of portables	2	2.4
Lack of exercise	2	2.4
Poor body mechanics	2	2.4
Employer	1	1.2
Awareness of work-related injury	1	1.2
Total	85	100.00

Note: missing cases: 11 (11.5%).

Eight (9.4%) of the 85 respondents with work-related symptoms indicated that they changed their job duties as a result of work-related symptoms. Four (4.7%) respondents changed lighting, 24 (28.2%) changed layout of their workstation, 8 (9.4%) changed their equipment and 4 (4.7%) changed their technique.

Sixty-eight (70.8%) respondents received education concerning work-related injury, 24 (25.0%) did not receive education, and 4.2% did not respond. The primary sources of education were physical therapists (60.3%), other sonographers (42.6%) and self study (41.2%). Only 17.6% indicated they received education concerning work-related injury from their clinical instructors during training.

The responses to the single most important factor that could result in an increase in work-related injuries in diagnostic sonographers over the next 3 to 5 years were grouped according to categories which emerged from the data. The factors which could result in an increase in work-related injuries among diagnostic sonographers are presented in Table 6.

5. Discussion

Since it is common to have returns of less than 40 to 50 percent for mail surveys, this response rate (61.5%) was considered to be an adequate sample of sonographers in Alberta.

The results of this survey demonstrate that work-related injuries are a common problem among diagnostic medical sonographers. In this study 88.5% of respondents reported work-related injuries. These results are slightly higher than the 86% reported by Vanderpool et al. (1993) in the study of carpal tunnel syndrome and other work-related musculoskeletal problems in cardiac sonographers. Since video display units are utilized by sonographers in the performance of sonograms it seems reasonable to compare injury statistics of video display terminal users and sonographers. As reported to the Bureau of National Affairs (BNA Plus, 1991), the Communication Workers of America estimated that 30 to 60% of video display terminal operators experience repetitive strain injuries. The percentage of sonographers with work-related injuries is higher than that of video display operators as reported to BNA. The percentage of those with work-related injuries in this study is likely higher because of the additional activities performed by sonographers.

In the study of carpal tunnel syndrome and other work-related musculoskeletal problems in cardiac sonographers, Vanderpool et al. (1993) reported that 90.4% of the females and 75% of the males in the study had work-related symptoms. In this study a higher percentage of females had work-related symptoms (94%) than males (54%). The difference in the percentages of females compared to males with work-related injuries can not be explained by differences in work activities, since female and male sonographers perform the same work activities. A possible explanation for the higher percentage of injuries in females is the relatively lower general physical size and strength of females compared to males as reported by Sikorski (1988). Sonography systems are heavy (450–550 pounds) and relatively unadjustable for height variation. The higher percentages of respondents with work-related symptoms in lower weight and height categories may reflect the limitations of the current equipment.

The higher percentages of respondents with work-related injuries found in the lower age groups (25–44 years) is contrary to what one might expect. Sonography is a relatively new profession so there is not an abundance of sonographers over the age of

40. It is possible that older sonographers who had work-related symptoms may have left the profession to seek physically less stressful work, or may have retired.

All sonographers who indicated extreme dissatisfaction, dissatisfaction, or no response concerning job satisfaction had work-related symptoms. These findings were supported by Sikorski (1988) who reported that the risk of work-related injury appears greater if emotional stresses are high and job satisfaction is low. Caution should be exercised in interpreting the results since one does not know whether the dissatisfaction was present before the onset of work-related symptoms or if it occurred as a result of work-related symptoms. Although the relationship between job satisfaction and resolution of symptoms was not significant, it is interesting to note that the work-related symptoms had not resolved among 10 of the 11 sonographers who indicated extreme dissatisfaction, dissatisfaction or no response concerning job satisfaction.

The visual problems, though not as prevalent as other problems, were also reported among diagnostic sonographers as reported by others (Craig, 1985; Craig, 1990; Ong, 1994). Visual problems among sonographers may be compounded by working in a dark environment for much of the work day.

With the combination of the isometric activity and the abducted position of the shoulder it is reasonable to expect the significant relationship between cluster 1 and shoulder abduction (level of involvement and contribution to injury). In the study of carpal tunnel syndrome and other musculoskeletal problems in cardiac sonographers, Vanderpool et al. (1993) reported that twisted posture correlated positively with physical symptoms ($r = 0.32$, $p \leq 0.002$). The significant correlations between cluster 1 and sustained and repetitive twisting of the neck and trunk indicate that these activities are problems of sonographers in general, rather than strictly problems of cardiac sonographers. The negative correlation between cluster 1 and level of involvement in clerical work is contrary to what one might expect. A possible reason for the negative correlation is that other factors may aggravate or compound the neck and interscapular pain.

Although 88.5% of respondents reported that they had experienced work-related symptoms, only 9.4% indicated that they changed their job duties as a result of work-related injury. According to sonographers the easiest changes to make were related to the work station and work methods. Although 28.2% of respondents indicated they changed the layout of the workstation, the types of changes made were not explored. Changing the layout may reduce or eliminate the current work-related symptoms. However, it is possible that the change may facilitate occurrence of repetitive strain injury in other parts of the body. Changing the scanning technique, particularly switching from right to left handed scanning, is a concern of sonographers. Right handed scanners are concerned that this may increase scanning time and decrease the accuracy of the results. The low percentage of sonographers who switched from right to left handed scanning may reflect this concern. Since equipment is very costly, the low percentage of respondents who made changes to equipment is not unexpected.

The relatively low percentage of sonographers who received education about work-related injuries from their clinical instructors is a concern. Given the repetitive nature of the work and the large numbers of sonographers who experience work-related symptoms, it becomes imperative that education concerning prevention of work-related injury among sonographers be included as part of the curriculum.

Craig (1985) reported that the area of greatest concern to sonographers was stress and burnout. In this study only four respondents indicated that mental stress could result in an increase in work-related injuries over the next 3–5 years. This low response concerning mental stress may be due in part to the small sample size. Another possibility is that mental stress may have been downplayed because so many of the respondents were experiencing physical symptoms.

6. Conclusion

It is apparent that work-related symptoms are a common problem among diagnostic sonographers. Consequences such as absenteeism, compensation, rehabilitation and lost productivity associated with work-related injuries among sonographers likely contribute to the overall costs of health care. The combi-

nation of new technology with resultant increases in duration and numbers of sonograms, and the trend to downsize in organizations, may contribute to an increase in work-related injuries in the near future.

At present, the design of equipment rests with the equipment manufacturers. Sonographers should be strongly encouraged to work cooperatively with manufacturers to facilitate design of more ergonomically desirable equipment. Education of sonographers, employers and equipment manufacturers is important to increase awareness of work-related injuries.

More formal research into epidemiology, etiology and prevention of work-related injuries among sonographers is needed. Further research based on observation is needed to examine risk factors, and to identify preventative measures so that sonographers can work with a lower risk of developing work-related injuries in the future.

7. For further reading

Browne et al., 1988; Burry and Stoke, 1985; Falkenburg and Schultz, 1993; Ireland, 1986; Isernhagen, 1988a; Isernhagen, 1988b; Kelsey et al., 1979; Putz-Anderson, 1988.

Appendix A. Questionnaire

Please check (✔) only one box in **each** section as appropriate unless otherwise indicated.

1. Sex	Code	✔
Male	01	
Female	02	

2. Age (in years)	Code	✔
Under 25	01	
25–34	02	
35–44	03	
45–54	04	
55–64	05	
Over 64	06	

3. Height (no shoes)	Code	✔
Under 5′0″	01	
5′1″–5′3″	02	
5′4″–5′6″	03	
5′7″–5′9″	04	
5′10″–6′0″	05	
6′1″–6′3″	06	
6′4″–6′6″	07	
Over 6′6″	08	

4. Weight (in pounds)	Code	✔
Under 90 lbs	01	
90–109	02	
110–129	03	
130–149	04	
150–169	05	
170–189	06	
190–209	07	
210–229	08	
230–249	09	
250–269	10	
Over 269	11	

5. Place of employment	Code	✔
Hospital	01	
Private clinic	02	
Other (specify)	03	
.....		

6. Province/territory in which you trained	Code	✔
Alberta	01	
British Columbia	02	
Manitoba	03	
New Brunswick	04	
Newfoundland/Labrador	05	
N.W.T	06	
Nova Scotia	07	
Ontario	08	
P.E.I.	09	
Quebec	10	
Saskatchewan	11	
Yukon	12	
Other (specify)	13	
.....		

7. Indicate (✓) if you wear corrective lenses (contacts, glasses, etc.)	Code	✓
Yes	1	
No	2	
If no, go to question 10		

8. Indicate (✓) type of lenses worn	Code	✓
Single vision	01	
Bifocals	02	
Trifocals	03	
Contacts	04	
Lineless bifocals	05	

9. Indicate (✓) when you received your **first** lenses	Code	✓
Before training/working as a sonographer	01	
After starting training/work as a sonographer	02	

10. On average, indicate (✓) the number of times per week that you exercise **continuously** at a moderate pace for at least 20 minutes (walking, cycling, swimming, etc.)	Code	✓
Never	01	
1 or 2 times/week	02	
3 or 4 times/week	03	
5 or 6 times/week	04	
7 or 8 times/week	05	
More than 8 times/week	06	

11. Choose the **one** response that best compares your present activity level to your *average* activity level during the past 5 years	Code	✓
I presently exercise:		
considerably less often	01	
slightly less often	02	
the same number of times/wk	03	
slightly more often	04	
considerably more often	05	

The following statements/questions are related to your work as a sonographer.

12. Indicate (✓) which hand you scan with	Code	✓
Right	01	
Left	02	
Both	03	

13. Indicate (✓) how long ago you completed training	Code	✓
less than 5 years ago	01	
5–9 years ago	02	
10–14 years ago	03	
15–19 years ago	04	
20–24 years ago	05	
more than 24 years ago	06	

14. Since graduation/completion of training, based on earned annual hours (eg. based on $7\frac{3}{4}$ hour day with 2022.75 hrs equal to one year of service), identify the following:

a. Number of years of active full time service .....
b. Number of years of active part-time service .....
(Specify average part time hours/week) .....

15. Have you ever had, or do you currently have, a **work-related injury**?	Code	✓
Yes	01	
No	02	

16. Indicate (✓) if you ever had, or are currently experiencing any of the following symptoms **that you believe are a direct result of your work activities** (check as many as apply to you)	Code	✓
neck pain	01	
frontal headaches	02	
pain between shoulder blades	03	
shoulder or upper arm pain	04	
elbow pain	05	
hand or wrist pain	06	
numbness or tingling	07	
of fingers clumsiness of fingers	08	
low back pain	09	
pulling sensation of the eyes	10	

blurring of vision	11
redness/dryness of eyes	12
other (specify)	13
.....	

If you have never had, or are not experiencing any work-related symptoms go to question 23

17. Indicate (✓) if you have ever been diagnosed by a doctor as having any of the following problems (check as many as apply to you)	Code ✓
carpal tunnel syndrome	01
tendinitis	02
tenosynovitis	03
epicondylitis (tennis or golfer's elbow)	04
bursitis	05
ganglions	06
other (specify)	07
.....	

18. Indicate (✓) if your problem has resolved	Code ✓
Yes	01
No	02

19. If your problem has resolved, what in your opinion is the single most important intervention that has reduced or eliminated your work-related problem?

.....

20. Indicate (✓) any consequences of your **work-related injury**	Code ✓
Absenteeism from work	01
Indicate the total number of days absent from work based on a $7\frac{3}{4}$ hr day since the onset of your work-related injury	.....
Decreased number of working hours	02
Decreased ability to perform regular job duties	03
Other	04
.....	

21. As a result of your **work-related injury** indicate (✓) if you have utilized any of the following (check as many as apply)	**Code** ✓
sick leave	01
unemployment insurance	02
vacation leave	03
disability insurance	04
workers compensation	05
treatment (physiotherapy, chiropractic, etc.)	06
medications	07
other (specify)	08
.....	

22. As a result of your **work-related injury**, indicate (✓) if you have had to change any of the following	**Code** ✓
Job duties	01
Equipment	02
Layout of work station	03
Lighting	04
Other (specify)	05
.....	

23. Indicate (✓) if you have received education concerning work-related injury (types of injury, causes, prevention)	Code ✓
Yes	01
No	02

24. If yes, indicate (✓) the source(s) of the education you have received concerning work-related injuries	Code ✓
instructors during training	01
physical therapists	02
occupational therapists	03
public health nurses	04
physicians/specialists	05
chiropractors	06
sonographers	07
ergonomists	08
self study	09
other (specify)	10
.....	

25. For each of the following work-related activities below, circle **your** level of involvement in the activity during the course of a typical work day (1 = no involvement, 5 = considerable involvement i.e. much of the day), and the degree to which you feel the activity contributes to work-related injury **for sonographers in general** (1 = no contribution to injury; 5 = very high contribution to injury for sonographers in general)

Activity	Level of involvement 1 = no involvement during day 5 = considerable involvement					Contribution to injury 1 = no contribution to injury 5 = very high contribution				
a. gripping transducer	1	2	3	4	5	1	2	3	4	5
b. applying sustained pressure with transducer	1	2	3	4	5	1	2	3	4	5
c. sustained shoulder abduction (ex. scanning apical 4 chamber with arm at approx. 90 degrees)	1	2	3	4	5	1	2	3	4	5
d. prolonged sitting	1	2	3	4	5	1	2	3	4	5
e. prolonged standing	1	2	3	4	5	1	2	3	4	5
f. performing on-line measurement	1	2	3	4	5	1	2	3	4	5
g. performing off-line measurement	1	2	3	4	5	1	2	3	4	5
h. sustained twisting of neck and trunk	1	2	3	4	5	1	2	3	4	5
i. repetitive twisting of neck and trunk to look from patient to monitor	1	2	3	4	5	1	2	3	4	5
j. lifting/assisting patients	1	2	3	4	5	1	2	3	4	5
k. transporting equipment for mobile studies	1	2	3	4	5	1	2	3	4	5
l. performing mobile studies	1	2	3	4	5	1	2	3	4	5
m. clerical work	1	2	3	4	5	1	2	3	4	5
n. changing cassettes	1	2	3	4	5	1	2	3	4	5
o. Other (specify)	1	2	3	4	5	1	2	3	4	5
.....	1	2	3	4	5	1	2	3	4	5
.....	1	2	3	4	5	1	2	3	4	5

26. Indicate (✓) the **one** response that **best** describes your **overall** job satisfaction	Code	✓
extremely dissatisfied	01	
dissatisfied	02	
no response	03	
satisfied	04	
extremely satisfied	05	

27. What in your opinion is the single most important factor that could result in an increase in work-related injuries in diagnostic sonographers over the next 3–5 years?

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Thank you for your responses!
Your time is sincerely appreciated
Please return by: Sept. 20, 1994

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