

# Musculoskeletal Pain in Cardiac Ultrasonographers: Results of a Random Survey

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Myalgias and arthralgias are common among workers whose jobs require repetitive isometric maneuvers or malalignment of body position. However, few systematic studies have been performed to evaluate the frequency of these complaints among cardiac ultrasonographers. Therefore the purpose of this study was to determine the prevalence of musculoskeletal pain (MSP) among ultrasonographers and to identify risk factors related to their occurrence. Two hundred twenty ultrasonographers randomly chosen from a list of more than 1600 active members of the American Society of Echocardiography were mailed surveys consisting of 22 questions. Included were questions regarding height, age, years of experience, frequency and type of physical exercise, and job-related parameters such as a number of scans per day, scanning from right or left side of bed, number of hours, bed type, type of equipment, and manual or self-propelled machines. Respondents were asked whether they had had back, neck, or shoulder pain related to their profession and to

describe treatment rendered and its effectiveness. One hundred thirteen (51%) of 220 ultrasonographers responded to the survey. Ninety (80%) of 113 respondents reported new pain that was not present before they began scanning, with 42 of this group (46%) requiring either physiotherapy ( $n = 17$ ) or medication ( $n = 23$ ). Treatment was believed to be helpful in 63% of cases. Factors found to have a positive relationship to MSP included ultrasonographer height less than 63 inches, performing 100 or more scans per month, average scan time of 25 minutes or more per patient, and use of manually propelled machines (each  $p < 0.05$ ). Factors found to have no relationship to MSP included age, type of equipment, right or left scan position, physical conditioning, bed type, and time between patients. Musculoskeletal pain is prevalent among cardiac ultrasonographers, and may have specific work-related factors for its occurrence. (*J Am Soc Echocardiogr* 1997;10:357-62.)

Muscle and joint pain are common complaints among workers whose jobs require repetitive isometric maneuvers or malalignment of body position. Dentists, bus drivers, and those who spend hours as computer keyboard operators have been shown to suffer from musculoskeletal pain syndromes, prompting studies into the working environment of these occupations.<sup>1-5</sup>

The performance of a cardiac ultrasound examination often requires the ultrasonographer to move echocardiography equipment and to exert sustained pressure with the transducer to acquire adequate

images, often from awkward scanning positions. Surveys of other occupations have identified work posture as a predisposing factor for neck, back, shoulder, and wrist pain.<sup>1</sup> Although similar complaints can be heard from cardiac ultrasonographers, few systematic studies have been performed to evaluate this group.<sup>6,7</sup> The object of our study was (1) to determine the prevalence of musculoskeletal pain (MSP) among cardiac ultrasonographers and (2) to identify risk factors related to the occurrence of MSP.

## METHODS

### Questionnaire

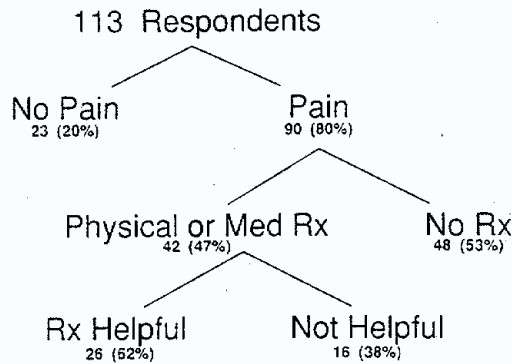
A survey was designed to identify whether cardiac ultrasonographers had back, shoulder, or neck pain related to their job. Twenty-two questions in the survey (Appendix) were derived, based on working conditions in our Adult Noninvasive Laboratory. Demographic data such as age, height, and frequency and type of physical exercise were requested to obtain a profile of physical conditioning in the respondents. Workload parameters included years of experience

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**Figure 1** Survey results from 220 cardiac sonographers. Respondents were categorized according to answers to questions 18-20 (see Appendix). Eighty percent of respondents described back, neck, or shoulder pain felt related to their profession.

**Table 1** Statistical analysis of survey responses comparing workplace variables and musculoskeletal pain among cardiac ultrasonographers ( $n = 113$ )

Variable	MSP ( $n = 90$ )	No pain ( $n = 23$ )	$p$ Value*
Demographic			
Age (mean; yr)	38.6	35.6	0.309
Height (mean; inches)	63.4	66.0	0.050
Cardiac studies (>50%) (%)	72	53	0.379
Adult studies (>50%) (%)	88	95	0.272
Experience (>5) (%)	80	83	0.694
Regular exercise (%)	63	68	0.781
Ergonomic			
Scan position (left side only) (%)	37	43	0.416
Hospital bed (%)	50	54	0.774
Studies/mo (>100) (%)	72	52	0.038
Time/patient (>25 min) (%)	78	65	0.047
Time between patients (<10 min) (%)	51	38	0.770
Break times (no) (%)	78	83	0.621
Lunch (<50 min) (%)	72	75	0.649
No. of technologists (mean)	2.22	2.62	0.07
Portability (manual) (%)	93	95	0.043

\*Probabilities from univariate  $\chi^2$  statistics for binary questions. Continuous variables were grouped (i.e., age = 5 years; height = 6 inches) for comparisons.

rience, patient volume per ultrasonographer per day, and time spent scanning each patient. Specific scanning conditions were considered, such as the type of ultrasound equipment and scan bed, time between patients, length of lunch break, and percentage of adult to pediatric patients. Information regarding transporting the equipment (whether motorized or manually propelled) was also requested.

#### Population Surveyed

The names and addresses of 220 cardiac ultrasonographers were randomly selected from a list of more than 1600 active

members of the American Society of Echocardiography. The survey was mailed to each ultrasonographer and included a self-addressed stamped return envelope.

Respondents were divided into two groups ("pain" and "no pain") depending on the answers to the questions: (1) Have you experienced any back, shoulder, or neck pain that you feel is related to your profession? and (2) Did you have this problem before you began scanning? The presence of musculoskeletal pain was defined by a "yes" and "no" response to these questions, respectively.

#### Statistical Analysis

In an effort to determine whether there were risk factors contributing to the presence of musculoskeletal pain, a univariate  $\chi^2$  method of statistical analysis was used, evaluating each factor separately as a continuous variable. A probability level of  $p \leq 0.05$  comparing pain and no pain groups was considered statistically significant.

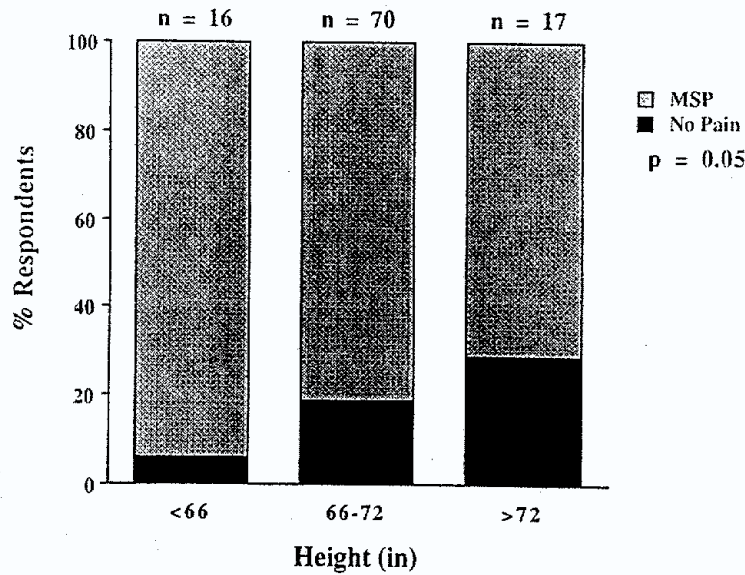
## RESULTS

One hundred thirteen (51%) of the 220 ultrasonographers responded to the survey. All were received within 1 month of the mailing date, and 50% were returned within the first week. The respondents represent 98 different echocardiography laboratories from all sections of the United States. Most of the commonly used types of commercially available echocardiographic equipment were represented.

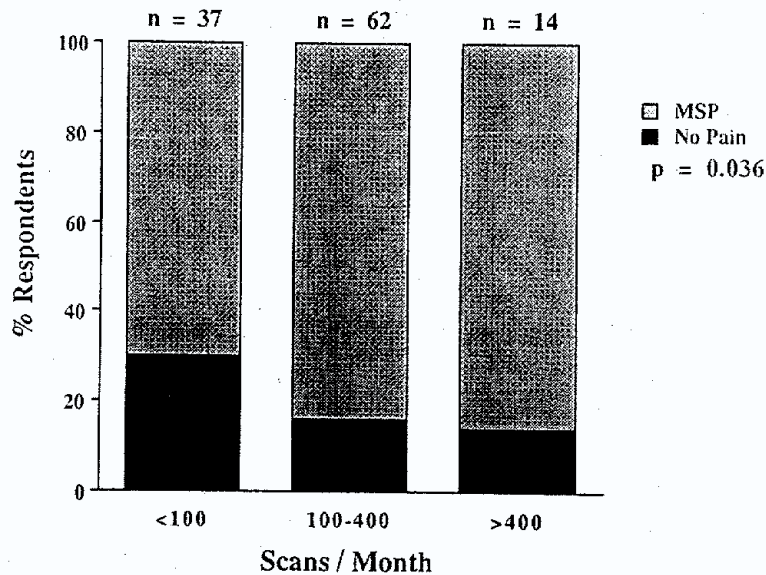
Of 113 respondents, 90 (80%) reported having had back, neck, or shoulder pain, whereas 23 (20%) reported no pain (Figure 1). Of the 90 reporting MSP, 42 (47%) sought physical therapy or medical treatment and 48 (53%) did not. Of the 42 who sought physical therapy or medical treatment, 26 (62%) found the treatment to be helpful and 16 (38%) did not find treatment beneficial. Two respondents did not comment on this question.

Four factors were found to have a statistically significant relationship to MSP: the ultrasonographer's height, the number of scans per month, scan time per study, and manually propelled machines (Table 1). Mean height for the pain group was 63.4 inches compared with 66.0 inches for the no pain group ( $p < 0.05$ ) (Table 1). Ultrasonographers less than 63 inches in height reported a proportionally higher incidence of pain: 17% versus 4% ( $p < 0.05$ ) (Figure 2).

Two workload parameters were identified to be statistically significant (Table 1). Of the 90 respondents with pain, 64 (72%) reported performing more than 100 scans per month, whereas only 12 (52%) of the 23 respondents in the no pain group performed



**Figure 2** Bar graphs relating sonographer height with either musculoskeletal pain (*MSP*) or no pain. The prevalence of *MSP* was significantly higher in workers less than 66 inches tall; 96% of respondents less than 63 inches had pain.



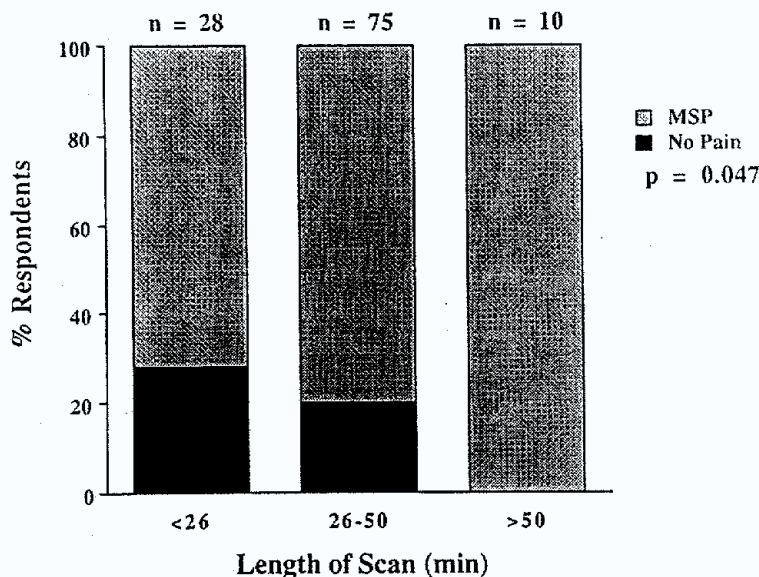
**Figure 3** Bar graphs comparing the prevalence of musculoskeletal pains (*MSP*) with the average number of echo studies performed each month. The number of scans are subdivided due to the wide range of responses. Ninety percent of sonographers performing over 100 scans/month had *MSP* ( $p = 0.036$  for both categories).

more than 100 scans per month ( $p = 0.038$ ) (Figure 3).

In the pain group, 70 respondents (78%) reported scan times of greater than 25 minutes per patient, whereas 15 (65%) of the no pain group reported scan times this long ( $p = 0.047$ ) (Figure 4). Moreover, of 10 ultrasonographers who reported greater than 50 minutes per scan, all had *MSP*.

Portability of machines was also found to have a relationship to *MSP*. Of the 102 respondents who used manually propelled machines, 81 (79%) had pain, whereas 21 (21%) did not ( $p = 0.043$ ). However, only seven total respondents reported the use of self-propelled or motorized equipment.

The remaining factors were found to have no relationship to *MSP*, including age, type of equipment,



**Figure 4** Bar graphs comparing average length of time for performing an echo study with the presence of musculoskeletal pain (MSP). All sonographers whose scans lasted >50 minutes had MSP ( $p = 0.047$ ).

right or left scan positions, physical conditioning or frequency of exercise, bed type, percentage of adult patients, and length of lunch and break times. Adequate information was not available regarding "time between patients," because 28% of the respondents did not answer this question. The number of full-time ultrasonographers working in each laboratory surveyed appeared to have a trend toward correlation; respondents with MSP had a mean of 2.2 ultrasonographers, and those without pain had a mean of 2.62 ultrasonographers ( $p = 0.07$ ). Although the statistic did not reach significant levels, laboratories with more technologists may be less likely to have pain.

## DISCUSSION

### Occupation-Related MSP

Our investigation demonstrates that MSP is prevalent among cardiac ultrasonographers (80% of respondents). Although this may be perceived as a high frequency of complaints, the prevalence is similar to that reported for other occupations requiring a seated work posture with repetitive arm or shoulder pressure and motion.

A study from the San Francisco Spine Institute regarding back pain in bus drivers indicated that 80% of drivers had back or neck pain at the time of examination, in contrast to 50% of nondrivers examined.<sup>2</sup> The increase in back pain in drivers appeared to

be related to years on the job, body habitus, and equipment design.

Similar results were reported by Rundcrantz et al.<sup>1</sup> in Sweden regarding cervical and shoulder pain among dentists. Their questionnaire, answered by 359 dentists, revealed that 73% of dentists had pain or discomfort from the neck and shoulders along with headaches. Only 17% had no pain or discomfort. Although many factors may produce these symptoms, the most common appears to be work posture.<sup>1</sup>

### Studies of Ultrasonographers

Craig<sup>7</sup> first described the occupational hazards of ultrasonography in 1985. This article discussed health-related complaints of eye strain, muscle strain, electrical shock, allergies, back injuries, and stress. Although no data were presented, the article provided important insight into common problems and corrective measures within the scanning environment. Back, neck, and shoulder pain was mentioned frequently, but no prevalence was given.

Vanderpool et al.<sup>6</sup> have recently published a similar study that surveyed 225 cardiac ultrasonographers on the prevalence of carpal tunnel syndrome.<sup>6</sup> As in our study, the authors evaluated a number of ergonomic factors and their relationship to musculoskeletal complaints. They found insufficient (or "twisted") posture and high-pressure hand grip, as well as duration of examination time, to correlate significantly with symptoms. Their study did not demonstrate a signif-

icant relationship between physical activity, work experience, or scan position and symptoms.<sup>6</sup>

Contrary to their data, our survey showed back, neck, and shoulder pain to have a direct correlation with the number of studies individual ultrasonographers performed each month, with greater than 100 scans per month as an important cutoff value. Our questionnaire also found ultrasonographer height of less than 63 inches to be associated more commonly with MSP.

A potential limitation of survey-type data is that there is a tendency for those with complaints to be more likely to respond. However, in our study if all 107 of the members of the American Society of Echocardiography who did not return the questionnaire were hypothetically assumed to be in the no pain group, the prevalence of MSP remains at 90 of 220, or 41%. Thus these data suggest that MSP is a common problem for cardiac ultrasonographers.

#### Factors Associated with MSP

Although a number of work-environment parameters were evaluated, only four were found to be significantly related to MSP.

Two factors, the number of studies and scan time, relate directly to ultrasonographer workload. For the 113 respondents, there was a wide range in study volume, from 30 to 300 echocardiographic studies per month (mean =  $157 \pm 36$  studies per month and median = 140 studies). The random questionnaire also demonstrated a large difference between laboratories for scan time, with a range of 10 to 60 minutes per scan (mean =  $35 \pm 9$  minutes per scan and median = 32 minutes). Thus it appears that excessive scanning for long periods, each day may lead to muscle fatigue and inflammation of tendons, joints, and bursae.

The indirect relationship between height and MSP may be related to work posture. Previous studies have shown that when the arms are abducted more than 45 degrees, the static load on muscles is increased markedly.<sup>8,9</sup> Further, working positions that involve constant turning and bending of the cervical spine pose an increased load. Based on our data, ultrasonographers with shorter stature (and relatively shorter arms) may be particularly vulnerable to these problems.

One of the major advantages of cardiac ultrasonography is the portability of equipment, which allows its use in a number of hospital sites, including emergency and operating rooms, intensive care units, and catheterization laboratories. The use of motorized transport for echocardiographic equipment appears to be associated with the lack of MSP. However, only seven respondents in this study used such devices.

Although cumbersome and potentially hazardous, our data suggest that they may reduce back and shoulder strain caused by pushing and lifting equipment. According to statistics from the Bureau of Labor (1992), the placing, grasping, or moving of heavy objects accounted for 31% of repetitive strain injuries in the U.S. workplace.<sup>10</sup>

Surprisingly, a number of factors were not related to the presence of MSP. Age, years of experience, physical conditioning, bed type, and time between patients were not shown to be significantly different between the pain and no-pain groups: Of note, 89 (79%) of 113 respondents reported no scheduled break times in their laboratories.

Although the merits of scanning from the right or left side of the bed have been debated since the early days of cardiac ultrasonography, no statistical difference was shown for this parameter. However, because the questionnaire did not include "handedness," it is still possible that ultrasonographers who use the nondominant (and presumably weaker) hand may be more prone to MSP.

#### Potential Solutions

The best treatment approach to MSP in ultrasonographers is prevention.<sup>9</sup> This survey has identified some common occupational factors associated with the development of MSP. Although changing these factors may not always be feasible in a busy laboratory, an ergonomic analysis of the working environment may reveal problem areas. In 1992 there were 89,900 cases of lost work because of these types of repetitive strain injuries.<sup>10</sup> Further studies are needed to determine whether alteration in work routines, such as limiting scan time, reducing the number of procedures per month, or rotating tasks, will eliminate the occurrence of MSP.

Fortunately, respondents who had pain syndromes were helped by treatment. The majority (63%) found simple physiotherapy (heat and massage), rest, or antiinflammatory medications to be beneficial. Specific exercise programs have also been designed to counter the effects of sustained and repetitive motion injuries encountered in the workplace.<sup>7,11,12</sup>

#### Conclusion

Like many other jobs requiring frequent use of repetitive motion or isometric muscle tension, cardiac ultrasonographers have a high prevalence of back, neck, and shoulder pains. Several common work-environment factors appear to be related to these complaints. Hopefully, this study will encourage managers and directors of cardiac ultrasound laboratories to evaluate the ergonomics of their workplace

and institute preventive measures to allow employees in this profession to remain productive.

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**APPENDIX**

1. Age \_\_\_\_\_
2. Height \_\_\_\_\_
3. Years of experience at echocardiography \_\_\_\_\_
4. What percent are pediatrics? \_\_\_\_\_ What percent are adults? \_\_\_\_\_
5. Do you perform studies other than echocardiograms? \_\_\_\_\_  
Please indicate other studies performed? \_\_\_\_\_
6. Do you scan from the patient's right or left side of the bed? \_\_\_\_\_
7. Do you use a bed or stretcher for your patients? \_\_\_\_\_
8. How many patients do you scan per day on average? \_\_\_\_\_/day
9. Average time spent doing one patient \_\_\_\_\_/minutes
10. Time in between patients \_\_\_\_\_/minutes
11. Do you have scheduled break times throughout your day? YES NO If so, how long? \_\_\_\_\_/minutes.
12. How much time is allotted for lunch? \_\_\_\_\_/minutes
13. How many technologists are employed in your

- lab? \_\_\_\_\_ full-time \_\_\_\_\_ part time
14. How many echocardiograms are done per month in your lab on average? \_\_\_\_\_
  15. Do you transport your ultrasound machines?  
YES NO
  16. Are your machines self-propelled? \_\_\_\_\_
  17. What brand of ultrasound equipment do you use? Which do you use more often?
  18. Have you ever experienced any back, shoulder, or neck pain that you feel is related to your profession? Did you have this problem before you began scanning? \_\_\_\_\_
  19. Have you ever been treated for this pain? If so, what type of treatment? \_\_\_\_\_
  20. Have you found this treatment helpful? \_\_\_\_\_
  21. Do you exercise on a regular basis?  
YES NO
  22. What type of exercise and how often?

TYPE OF EXERCISE	TIMES/WEEK
Jogging	_____
Biking	_____
Aerobics	_____
Weight lifting	_____
Other	_____