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Work-related Musculoskeletal Disorders among Medical Staff in a Radiology Department

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Background: The aim was to investigate the association between musculoskeletal disorders (MSD) and work-related risk factors in the medical staff in a single radiology department. **Methods:** The study was conducted in a radiology department with 107 staff members. A self-administered, modified Nordic Musculoskeletal Questionnaire was used to determine work practices, work descriptions, prolonged postures and movements, and body pain. Ninety-seven questionnaires (93.3% response) were returned for analysis. **Results:** The majority of respondents (77.3%) reported at least one episode of body pain during the previous year. Less than half (44.3%) of respondents were able to have time off during work shifts, and 42.3% worked more than eight hours per shift. Pain in the neck or shoulder (61.9%) was the most common complaint. There was a lower incidence of body pain for staff members who could arrange at least some time off during the work shift than for staff unable to do so. **Conclusions:** MSD among staff in the radiology department were related to work posture and movement. Time off taken during a work shift appeared to be a protective factor lowering the incidence of pain in all parts of the body.

Key words: musculoskeletal disorders, occupational risk factor, radiology department

INTRODUCTION

Our colleagues on the medical staff in a radiology department frequently complained of MSD, usually involving the shoulders and back. The offending factors were assumed to be the daily exposure to different radiology tasks such as moving and positioning patients for imaging. Radiologists spend most of their time archiving pictures and generating reports, spending less time on diagnostic or interventional angiography. When performing angiography, radiologists routinely wore radiation protective aprons weighing approximately 4.3 kg. Nurses primarily attended to the health of patients. If a contrast-enhanced imaging study was required, nurses set up the intravenous line and manually injected the contrast medium. The archivists, physicists, and assistants rotated between different department sections to gather and manage patient information and imaging data.

We believed that if we discovered the risk factors associated with MSD, the standard operative procedures could be modified to provide a safer working environment. There are few occupational health surveys on radiology staff in the literature. We examined the associations between MSD and work-related risk factors in our radiology department.

METHODS

Population

The study population was the entire medical staff in the Department of Radiology of Tri-Service General Hospital, National Defense Medical Center, Taipei. A total of 107 staff members were invited to participate in the survey. Seven declined to participate, with 100 staff participating (93.5% response rate). The staff completed the questionnaire during a regular meeting after being briefed by the researchers. During the briefing, the researchers explained the background and rationale of the study. Staff members were reassured that individual identification was not required in the questionnaire and that the information pro-

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vided would be confidential. Staff members required 15-30 minutes to fill in the questionnaire.

Questionnaires

The questionnaire contained questions on work characteristics, work description, postures maintained for prolonged periods, movement patterns, and body pain. Respondents were asked to indicate areas where they experienced pain on a body map modified from the Nordic Musculoskeletal Questionnaire. We reduced the information on pain experienced during the preceding year to five categories from descriptions involving the neck, shoulders, elbows, wrists, upper back, lower back, thighs/buttocks, knees, or ankles/feet. Pain felt in the neck and shoulders was classified as upper-back pain; pain in the elbows and wrists were classified as upper-limb pain; pain in the thighs/buttocks as lower-back pain, and knees and ankles/feet as lower-limb pain, resulting in the five categories. Respondents were asked if the symptoms were related to their work, resulting in three categories (fully related, partially related and not related). Only those symptoms partially or fully related to work were included in the statistical analysis.

Exposure was measured by the time spent per workday moving patients, standing, sitting, or using computers. Other variables recorded included the duration of any time off in a workday, time in different sections, and the time spent working in the department. Overtime work was defined as more than eight hours per work shift. The body mass index (BMI) of each respondent was calculated and divided into two categories: a BMI of 24 or less was defined as normal, and a BMI of more than 24 was defined as overweight.

Statistical Analysis

All data were expressed as mean±SD or as a percentage. The demographic characteristics of the subjects and potential risk factors of MSD were assessed using the t test or one-way ANOVA to compare means and the chi-square test to compare rates of events. Only those variables that were statistically significant ($p < 0.05$) or marginally significant ($p < 0.1$) in the bivariate analyses were included for subsequent multivariable analyses. Logistic regression analyses were used to examine the relationships between potential risk factors and MSD. Estimates of odds ratios (OR) and associated 95% confidence intervals (CI) were obtained from these models. All statistical analyses were two tailed.

Table 1 Characteristics of the study population

	Respondents	
	No.	%
Age (years)		
<25	5	5.2
25-34	26	26.8
35-44	48	49.5
45-54	18	18.6
Age, mean ± SD	38.3 ± 5.3 years	
Body height, mean ± SD	164.7 ± 8.3 cm	
Body weight, mean ± SD	60.9 ± 13.0 kg	
Body mass index, mean ± SD	22.5 ± 3.4	
Years worked in the department		
1-5	45	46.4
>5-10	24	24.7
>10-20	18	18.6
>20	10	10.3
Job designation		
Radiologist	20	20.6
Technologist	55	56.7
Nurse	6	6.2
Others	16	15.5
Archivist	11	11.3
Physicist	2	2.1
Assistant	3	3.1
Work section of technologist		
MRI	7	12.7
CT	17	30.9
X-ray	24	43.6
US	4	7.3
Others	3	5.5

RESULTS

Participants

One hundred medical staff completed the survey, but pregnant women were excluded, making the total 97 completed questionnaires. Table 1 shows the background characteristics of the respondents. The respondents were 38.3 ±5.3 years old and weighed an average of 60.9±13.0 kg with a mean BMI of 22.5±3.4. The majority (46.4%) had worked at the department for less than five years, followed by those who had worked 5-10 years (24.7%). Job descriptions included radiologist, technologist, nurse, archivist, physicist, and assistant. Technologists were more than half the population (56.7%). The technologists' work was divided into five areas, including examination rooms for magnetic resonance imaging (MRI), computed tomography (CT), X-ray, ultrasonography (US), and others. The majority of our staff worked in X-ray (43.6%), with 30.9% in CT, 12.7% in MRI, 7.3% in US, and 5.5% in the category ‘other’. In the category ‘other’, technologists rotated between categories.

Table 2 Exposures and outcomes

	Respondents	
	No.	%
Time-off		
Yes	54	55.7
Times, mean ± SD	1.3 ± 0.9	
Duration, mean ± SD	42.9 ± 23.2	minutes
No	43	44.3
Overtime work		
Yes	41	42.3
No	56	57.7
Radiologist	17	41.5
Duration, mean ± SD	11.5 ± 1.9 hours	
Technologist	21	51.2
Duration, mean ± SD	11.6 ± 1.7 hours	
Others	3	7.3
Duration, mean ± SD	9 ± 0 hours	
Body pain experienced in the last one year		
Any part of the body	75	77.3
Neck/shoulder*	60	61.9
Neck	45	46.4
Shoulder	53	54.6
Upper limb*	37	38.1
Elbow	10	10.3
Wrist	34	35.1
Upper back	20	20.6
Lower back	46	47.4
Lower limb*	24	24.7
Thigh/buttock	9	9.3
Knee	15	15.5
Ankle/foot	10	10.3

*Respondents indicating pain in a body region would be those who indicate pain in the body part/parts making oup the region. For example, respondents indicating pain in "neck/shoulder" will not be the sum of those feeling pain in the neck and of those feeling pain in the shoulder because those who indicate pain in both neck and shoulder will be counted only once.

Outcomes

Less than half (44.3%) of the respondents were able to take time off during work shifts, and 42.3% worked for more than eight hours per shift (Table 2). Staff took an average of 42.9±23.2 minutes per time off, 1.3 ± 0.9 times per shift. Overtime work was reported by 42.3% of respondents, of which about half (51.2%) were technologists who worked 11.6±1.7 hours per shift. The majority of respondents (77.3%) complained of at least one episode of body pain during the previous year. Pain in the neck/shoulder (61.9%) was the most frequent complaint among staff. A high percentage also reported pain in the lower back (47.4%) and upper limb (38.1%). In a total 311 locations for body pain, 94.2% were partially or fully related to the type of work, resulting in 293 body locations being suitable for analysis (Table 3).

Table 4 shows the location of body pain of all respondents in relation to seven exposure factors. Age, job description, work section, and overtime work were not

Table 3 Relationship of the work and outcomes

	Fully-related		Partially-related		Not-related	
	No.	%	No.	%	No.	%
(n=134)	43	32.1	85	63.4	6	4.5
Upper limb (n=59)	38	64.4	20	33.9	1	1.7
Upper back (n=21)	6	28.6	13	61.9	2	9.5
Lower back (n=46)	19	41.3	22	47.8	5	10.9
Lower limb (n=51)	19	37.3	28	54.9	4	7.8
Total (311)	125	40.2	168	54	18	5.8

significantly correlated with any particular body pain. In contrast, BMI, years worked, and time off were positively correlated with body pain. Respondents who were overweight or had worked for less than 10 years were prone to neck/shoulder disorders ($p = 0.04$ for overweight; $p = 0.06$ for years worked). After adjusting for potential confounders, the risk of neck/shoulder pain was weakly associated with BMI (OR = 2.5, 95% CI: 0.8-7.7) and years worked (OR = 0.4, 95% CI: 0.18-1.03) (data not shown). Respondents who had at least one time off during work shifts had fewer reports of body pain, particularly in the lower limbs ($p = 0.01$), than those who had no time off. It was surprising that prolonged exposures of more than eight hours per shift did not produce a significant increase in pain prevalence in any body part.

The majority of our department (56.7%) consisted of technologists. Table 5 specifically shows the relationships between body pain reports and four exposure risks (work section, years worked, time off, and overtime work) for this group. As in the analysis for the whole department (Table 4), a similar trend of low numbers of body pain reports in technologists who had time-off periods was found. The correlation was more obvious for pain in the upper and lower limbs ($p = 0.08$ and 0.05, respectively). Generally, there was no significant relationship between body pain and the work section of the technologists. Years worked and overtime were not significantly associated with any particular body pain. There was, however, a high incidence of neck/shoulder pain among US technologists (75%). Further analysis of body pain in technologists in CT and MRI showed a significant association between lower-back pain and working in the CT section ($p = 0.009$).

DISCUSSION

Overall Prevalence

We found a high prevalence of body pain among participants (77.3%). We believe this is the first study to investigate MSD in medical staff in a radiology department using a modified Nordic Questionnaire. A significant finding

Table 4 Body pain of respondents

Body pain	Respondents (n=97)									
	Neck/shoulder		Upper limb		Upper back		Lower back		Lower limb	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Age	36.5(8.1)	39.2(8.4)	37.6(8.4)	37.5(8.3.)	36.4(7.8)	37.8(8.5)	37.1(7.3)	38.0(9.2)	36.4(7.7)	37.9(8.5)
BMI										
Normal	40**(56.3)	31**(43.7)	23(32.4)	48(67.6)	16(22.5)	55(77.5)	35(49.3)	36(50.7)	19(26.8)	52(73.2)
Overweight	19**(79.2)	5**(20.8)	15(50.0)	12(50.0)	4(16.7)	20(83.3)	10(41.7)	14(58.3)	5(20.8)	19(79.2)
Job dedignation										
Radionlogist	13(65.0)	7(35.0)	9(45.0)	11(55.0)	2(10.0)	18(90.0)	11(55.0)	9(45.0)	3(15.0)	17(85.0)
Technologist	33(60.3)	22(40.0)	18(32.7)(	37(67.3)	13(23.6)	42(76.4)	26(47.3)	29(52.7)	17(30.9)	38(69.1)
Nurse	5(85.5)	1816.7)	4(66.7)	2(33.3)	0(0.0)	6(100.0)	1(16.7)	5(83.3)	0(0.0)	6(100.0)
Others	9(56.2)	7(4308)	6(37.5)	10(62.5)	5(31.2)	11(38.8)	8(50.0)	8(50.0)	4(25.0)	12(0.75)
Work section										
MRI	3(50.0)	3(50.0)	1(16.7)	5(83.3)	0(0.0)	6(100.0)	0(0.0)	6(100.0)	0(0.0)	6(100.0)
CT	10(62.5)	6(37.5)	5(31.3)	11(68.8)	5(31.3)	11(68.8)	10(62.5)	6(37.5)	3(18.8)	13(81.2)
X-ray	15(60.0)	10(40.0)	10(40.0)	15(60.0)	8(32.0)	17(68.0)	14(56.0)	11(44.0)	14(56.0)	11(44.0)
US	3(75.0)	1(25.0)	1(25.0)	3(75.0)	0(0.0)(	4(100.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)
Others	2(50.0)	2(50.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)
Years Woeked										
<10	38*(69.1)	17*(30.9)	20(36.4)	35(63.6)	11(20.0)	44(8.0)	28(50.9)	27(49.1)	14(25.5)	41(74.5)
>=10	19*(50.0)	19*(50.0)	15(39.5)	23(60.5)	8(21.1)	30(78.9)	16(42.1)	22(57.9)	9(23.7)	29(76.3)
Time off										
Yes	38(58.5)	27(41.5)	23(35.4)	42(64.6)	11(16.9)	54(83.1)	29(44.6)	36(55.4)	11***(16.9)	54***(83.1)
No	22(68.8)	10(31.3)	14(43.8)	18(56.3)	9(28.1)	23(71.9)	17(53.1)	15(46.9)	13***(40.6)	19***(59.4)
Overtime work										
Yes	24(60.0)	16(40.0)	14(35.0)	26(65.0)	8(20.0)	32(80.0)	23(57.5)	17(42.5)	9(22.5)	31(77.5)
No	33(62.3)	20(37.7)	21(39.6)	32(60.4)	11(20.8)	42(79.2)	22(41.5)	31(58.5)	15(28.3)	38(71.7)

*p<0.1; **p<0.05; ***p<0.01

from this study is that time off is an important protective factor.

Major Regions of Body Pain

Pain was most frequently experienced in the neck/shoulder (61.9%) or lower back (47.4%). In comparison with the study by Hoozemans et al. showing the effect of pushing/pulling on lower-back and shoulder complaints[1], our report rate of 47.4% is significantly higher than their result of 21% for lower-back pain. There was also a higher prevalence of neck/shoulder pain (61.9%) in our group compared with their rate of 41%. In a study of neck and shoulder pain in hospital nurses, a significantly lower rate (34%) than we observed was reported[2]. The high frequency of reports of pain in the neck/shoulder and lower-back regions suggests that our medical staff were exposed to a high level of pushing and pulling. Technologists frequently make these two movements when moving or positioning patients during radiological examinations.

Neck/shoulder Pain

We found an association between being overweight and neck/shoulder pain. However, the exact relationship between weight and neck/shoulder pain remains unclear. In a survey of 11,276 school children aged 12-18 years, Vikat *et al*. found that those within the lowest 15% of the BMI distribution had a higher incidence of neck/shoulder pain than those with higher a BMI[3]. However, Salminen found no relationship between neck and/or back pain and BMI in a 13- to 17-year-old population[4]. An interesting finding in our study was that younger staff with less than 10 years' work experience, were more likely to have neck/shoulder pain than more senior members. This may be the result of busy work schedules or the lower skill levels of younger staff members.

The sonographers (technologists working in the US section) had a high incidence of neck/shoulder pain. During diagnostic US, they sit with their neck and shoulders bent laterally. The relationship between neck/shoulder pain and sitting posture has been examined for workers from seven manufacturing industries in South Africa[5]. In our US section, a sonographer may scan 20-25 patients per shift and spend 5-10 minutes scanning a single patient. The repetitive nature of the task may increase the exposure risk. Chiang et al. found that shoulder-girdle (neck, shoulder, upper arms) pain was significantly higher among workers performing tasks with repetitive movements[6]. In a French longitudinal study, the incidence of neck and shoulder pain

Table 5 Body pain of technologists

Body pain		Respondents (n=55)									
		Neck/shoulder		Upper limb		Upper back		Lower back		Lower limb	
		Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Work section											
	MRI	3(50.0)	3(50.0)	1(16.7)	5(83.3)	0(0.0)	6(100.0)	0(0.0)	6(100.0)	0(0.0)	6(100.0)
	CT	10(37.5)	6(62.5)	5(31.3)	11(68.8)	5(31.3)	11(68.8)	10(62.5)	6(37.5)	3(18.8)	13(81.3)
	X-ray	15(60.0)	10(40.0)	10(40.0)	15(60.0)	8(32.0)	17(68.0)	14(56.0)	11(44.0)	14(56.0)	11(44.0)
	US	3(75.0)	1(25.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)
	Others	2(50.0)	2(50.0)	1(25.0)	3(75.0)	0(0.0)	4(100.0)	1(25.0)	3(25.0)	0(0.0)	4(100.0)
Years Woeked											
	<10	19(36.7)	11(63.3)	10(33.3)	20(66.7)	8(26.7)	22(73.3)	16(53.3)	14(46.7)	10(33.3)	20(66.7)
	>=10	13(54.2)	11(45.8)	7(29.2)	17(70.8)	5(20.8)	19(79.2)	10(41.7)	14(58.3)	7(29.2)	17(70.8)
Time-off											
	Yes	22(56.4)	17(43.6)	10*(25.6)	29*(74.4)	8(20.5)	31(79.5)	17(43.6)	22(56.4)	9**(23.1)	30**(76.9)
	No	11(68.8)	5(31.3)	8*(50.0)	8*(50.0)	5(31.3)	11(68.8)	9(56.3)	7(43.8)	8**(50.0)	8**(50.0)
Overtime work											
	Yes	11(52.4)	10(47.6)	5(23.8)	16(76.2)	3(14.3)	18(85.7)	11(52.4)	10(47.6)	5(23.8)	16(76.2)
	No	21(65.6)	11(34.4)	12(37.5)	20(62.5)	9(28.1)	23(71.9)	15(46.9)	17(53.1)	12(37.5)	20(62.5)

*p<0.1; **p<0.05

was significantly related to repetitive work involving time constraints and high job demand[7].

Upper-limb Pain

We found no significant association between upper-limb pain and apparent exposure risks. However, radiologists and nurses often complained of discomfort in the elbow and wrist. A radiologist may complete 100-150 radiological examination reports every day. This task requires 4-5 hours of intensive typing. Such prolonged exposure may be the cause of upper-limb pain. The nurses, all female, spend most of their time setting up intravenous injections of contrast medium. The strength required to push the syringe manually may make this task difficult.

Upper-limb pain was more common among X-ray technologists who repeatedly handle radiographic cassettes weighing approximately 0.8 kg. On average, 1.8 cassettes are required to complete a routine examination for each patient. In a working shift, an X-ray technologist may film 52 patients. Our results show a relationship between repetitive wrist movements and wrist or forearm pain, similar to the results of Jin et al[8].

Upper-back Pain

Archivists, physicists, and assistants report upper-back pain most often. They share the common work characteristic of frequently rotating between different department sections on two floors, gathering and managing patient records. Frequent stair climbing may contribute to the upper-back pain. Among technologists, upper-back pain reports were more frequent in the X-ray section. Most previous studies focused on pain in either the lower back or the whole back, rather than upper-back pain. Repeated strenuous physical activities such as lifting, pushing or pulling heavy objects, and repeated bending, twisting, or reaching may also be risk factors for back pain[9].

Lower-back Pain

The radiologists in our study complained most frequently of lower-back disorders. In addition to prolonged periods spent typing and sitting, they frequently performed angiographies. This procedure was very time consuming, taking up to hours, and required intense concentration and sophisticated techniques. During routine angiography (lasting an hour on average), radiologists stand beside the examination table wearing a lead apron weighing 4-6 kg. Lower-back pain is associated with lifting heavy loads, twisting, and bending the trunk[8]. Sitting is also a known risk factor for lower-back pain. In Jin's review of two studies, the incidence of back pain among sedentary workers was higher than for workers with free postures[8].

The technologists that worked in the CT section had the highest incidence of lower-back pain. They moved patients from sickbeds to examination tables on a regular basis. Although sliding devices are available to make patient movement easier, staff members were still exposed to higher risks from heavy lifting, twisting, and bending. It is interesting that CT technologists had a significantly

higher risk of lower-back pain than those working in the MRI. The operating procedures of the two sections were similar in moving and scanning patients. The only apparent difference was the fast workflow in the CT section. It generally took 30-45 minutes to complete a regular examination in MRI, whereas only 5-10 minutes were required in the CT section, with a 64 multidetector row CT. This suggested that workload was an important risk factor for lower-back pain in technologists in CT and MRI sections.

Lower-limb Pain

X-ray staff exposed to prolonged standing had the highest incidence of lower-limb pain. Ninety-two percent needed to stand for more than six hours during a work shift. Lower-limb pain is infrequently described in the literature, although a high prevalence has been found among electronics-assembly workers who stand for long periods of time[10]. We found that time off was a protective factor for MSD, and it may significantly lower the risk of lower-limb pain.

Study Limitations

Our study was limited because objective ergonomic measurements were not carried out, and nor were detailed quantitative observations on postures and movements. There may have been biased estimations because some staff declined to participate in the survey. Our study relied on self-reporting for measurements of exposures and outcomes. Psychosocial factors may have been important confounders[11], but were not within the scope of the study. The small population size was a limitation.

CONCLUSION

Our results suggest that working schedules and standard operating procedures could be modified to reduce work-related MSD.

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REFERENCES

1. Hoozemans MJ, van der Beek AJ, Frings-Dresen MH, van Dijk FJ, van der Woude LH. Pushing and pulling in relation to musculoskeletal disorders: a review of risk factors. Ergonomics 1998;41:757-781.
2. Smedley J, Inskip H, Trevelyan F, Buckle P, Cooper C, Coggon D. Risk factors for incident neck and shoulder pain in hospital nurses. Occup Environ Med 2003;60: 864-869.
3. Vikat A, Rimpela M, Salminen JJ, Rimpela A, Savolainen A, Virtanen SM. Neck or shoulder pain and low back pain in Finnish adolescents. Scand J Public Health 2000;28:164-173.
4. Salminen JJ. The adolescent back. A field survey of 370 Finnish schoolchildren. Acta Paediatr Scand Suppl 1984;315:1-122.
5. Schierhout GH, Meyers JE, Bridger RS. Work related musculoskeletal disorders and ergonomic stressors in the South African workforce. Occup Environ Med 1995;52:46-50.
6. Chiang HC, Ko YC, Chen SS, Yu HS, Wu TN, Chang PY. Prevalence of shoulder and upper-limb disorders among workers in the fish-processing industry. Scand J Work Environ Health 1993;19:126-131.
7. Cassou B, Derriennic F, Monfort C, Norton J, Touranchet A. Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. Occup Environ Med 2002;59:537-544.
8. Jin K, Sorock GS, Courtney T, Liang Y, Yao Z, Matz S, Ge L. Risk factors for work-related low back pain in the People's Republic of China. Int J Occup Environ Health 2000;6:26-33.
9. Guo HR. Working hours spent on repeated activities and prevalence of back pain. Occup Environ Med 2002;59:680-688.
10. Harlow SD, Becerril LA, Scholten JN, Sanchez Monroy D, Sanchez RA. The prevalence of musculoskeletal complaints among women in Tijuana, Mexico: sociodemographic and occupational risk factors. Int J Occup Environ Health 1999;5:267-275.
11. Kaergaard A, Andersen JH. Musculoskeletal disorders of the neck and shoulders in female sewing machine operators: prevalence, incidence, and prognosis. Occup Environ Med 2000;57:528-534