MEDICAL EDUCATION SYSTEMS, INC.

Course

Radiating Neck Pain

Medical Education Systems, Inc.

Longitudinal study on work related and individual risk factors affecting radiating neck pain

Learning Objectives

Upon successful completion of this course, you will be able to:

- List the effects of work related and individual factors affecting radiating neck pain.
- Identify the physical load factors experienced at work situations
- Identify the risk factors for neck and shoulder pain in nurses

Abstract

OBJECTIVES—To study the effects of work related and individual factors affecting radiating neck pain.

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METHODS—A longitudinal study was carried out with repeated measurements. A total of 5180 Finnish forest industry workers replied to a questionnaire survey in 1992 (response rate 75%). Response rates to follow up questionnaires in 1993, 1994, and 1995 were 83%, 77%, and 90%, respectively. The outcome variable was the number of days with radiating neck pain during the preceding 12 months with three levels (<8, 8-30, >30 days). The generalized estimating equations method was used to fit a marginal model and a transition model was used in a predictive analysis.

RESULTS—Items showing associations with radiating neck pain in both analyses were sex, age, body mass index, smoking, duration of work with a hand above shoulder level, mental stress, and other musculoskeletal pains. In the transition model, radiating neck pain in a previous questionnaire was included in the model. Although it was a strong predictor, the variables already mentioned retained their significance.

CONCLUSION—Programs targeted to reduce physical load at work, mental stress, being overweight, and smoking could potentially prevent radiating neck pain.

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Introduction

Many epidemiological studies have been carried out to assess environmental and individual risk factors for neck disorders.[1-7] There is evidence from both cross sectional and longitudinal studies that work with abducted arms,[1 8] forward flexion of the neck,[8] and repetitive movements of the hands or fingers[5 9] increase the risk of various neck disorders. Little is known about the intensity, frequency, or duration of the exposures associated with increased risk. To prevent neck disorders such information is necessary.

The quality of the assessment of physical load factors is essential in studies on musculoskeletal disorders. Objective measurements are considered more valid than subjective assessments. Practical circumstances and financial constraints may, however, preclude the use of objective assessment. Subjective assessment methods by questionnaire have been recently validated.[10 11] The results have shown that the questionnaire method is valid for some physical load factors at work—such as duration of sitting, walked distance, frequency of lifting loads heavier than 5 kg, duration of forward flexion of the trunk each day, working with a hand above shoulder level, and squatting or kneeling.

As well as physical load factors psychological and work organizational factors have been associated with neck disorders and symptoms.[12] These associations have been mostly found in cross sectional studies.[3 4] In a prospective study, Pietri-Taleb *et al* found that psychological distress and personality factors had some predictive value for neck trouble among a group of male workers, but the associations were complex and occupation specific.[6] In a 10 year follow up study, social relations among men, and work control among the women predicted a change in the disorders of the neck, shoulder, and upper limb.[13] The occurrence of neck pain and neck disorders increases with age until late middle age and decreases thereafter. They are more common among women than among men.[3]

In a follow up study the incidence or recurrence of a clearly defined disease should be studied. The problem with the neck is that we lack generally accepted diagnostic criteria for common neck disorders. In this situation we have to use various symptoms or pain syndromes as the outcome. Such outcomes often have many categories, and their statistical analysis has not been straightforward.

We carried out a longitudinal study with four repeated questionnaires among workers in a large forest industry enterprise. As well as analyzing the data with a marginal model, we wanted to do a predictive analysis (transition model), in which all information from a previous year was used to predict radiating pain. The purpose of our study was to investigate the effects of work related and individual factors on radiating neck pain.

Methods

STUDY POPULATION

A total of 7000 blue and white collar workers of a large forest industry enterprise in Finland was selected for the study. This group consisted of all workers in mechanical and chemical forest industry processes and their maintenance tasks, foremen, technical designers, laboratory staff, and office clerks. A questionnaire on musculoskeletal pain and potential risk factors was posted to all by the occupational health service of the enterprise in March 1992. Two reminders were sent to non-respondents. Altogether 75% of the subjects returned the questionnaire. A few subjects with rheumatoid arthritis and part time workers were excluded, leaving 5180 subjects in the study cohort. There were 3899 men and 1281 women. The mean ages of the men and women were 41.8 (SD 9.6) and 43.4 (SD 9.2) years, respectively. Follow up questionnaires were posted in March 1993, 1994, and 1995 to those who had responded to the previous questionnaire. Response rates were 83%, 77%, and 90%, respectively. The corresponding numbers of subjects were 4283, 3312, and 2984, and the percentages of the original sample were 62%, 48%, and 43%, respectively.

The younger subjects replied less often than the older ones and the men slightly less often than the women. Those who had finished work after the preceding questionnaire replied less often than those who were still employed. Of the workers aged less than 55 years, 93%-97% were employed in the company during the questionnaire surveys in 1993-5. Half of those older than 54 years in 1992 had finished work in 1993, and most had done so before the last year of follow up. There was no difference between the respondents and non-respondents in the occurrence of radiating neck pain in the previous year.

QUESTIONNAIRE

A modified version of the Nordic Questionnaire[14] was used to investigate pain in the following body regions: neck (pain radiating to the upper extremity and local pain were investigated separately); shoulder; forearm and hand; low back (sciatic pain, lumbago, and other types of local pain separately). Body shaped models were used to denote the anatomical area in question. The outcome in this study was radiating neck pain. The exact wording of the question was as follows: "Estimate the total number of days you have had neck pain radiating to the upper extremity during the preceding 12 months." The original question had five categories: 0 days, 1-7 days, 8-30 days, >30 days but not daily, daily. In the analysis, we combined the first two categories, because we think that some days with neck pain does not indicate a neck disorder. The last two categories were combined due to the few subjects with daily pain. Accordingly, a three category variable was used (0-7 days (healthy), 8-30 days (mild pain), >30 days (severe pain)).

In the 1992 questionnaire there were 14 questions on physical load factors at work, nine on work characteristics, and 28 on individual factors.[15] Eleven questions on physical load factors, all nine questions on work characteristics, and 24 questions on individual factors were repeated in the 1994 questionnaire and most questions were also repeated in the 1993 and 1995 questionnaire. Based on an earlier study with the 1992 and 1993 data[15] the following 17 variables were selected for the analysis as explanatory variables:

Physical load factors at work

- Physical strenuousness of work (five categories)

- Squatting or kneeling at work (hours/day, four categories)
- Working with the trunk forward flexed (hours/day, four categories)
- Amount of twisting movements of the trunk during a workday (four categories)
- Working with hand above shoulder level (hours/day, four categories)

Work characteristics[16]

- Mental strenuousness of work (five categories)
- Balance of work demands (influence on work, possibility to use knowledge and skills, scoring of both questions from 1 to 5, sum score variable)
- Overload at work (difficulty at work, hurry at work, scoring of both from 1 to 5, sum score variable)

Individual factors

- Sex
- Age in 1992 (four categories)
- Working in the target enterprise at the time of the questionnaire (yes, no)
- Body mass index (weight/height^2, four categories)
- Frequency of physical exercise (times/week, six categories)
- Smoking (non-, ex-, current smoker)
- Mental stress (five categories)
- Self assessed ability to work during the coming 5 years with regard to musculoskeletal health (no problems, problems possible, problems likely, used only in the transition model)
- Other musculoskeletal pains (severe pain in the following body areas: local neck pain; shoulder pain; forearm and hand pain; sciatic pain; lumbago; other local low back pain. Each pain scored 1, sum score range from 0 to 6).

The questions concerning postures of body parts were accompanied by body shaped models to illustrate the postures. The validity of three questions on working postures (squatting or kneeling, forward flexion of the trunk, and a hand above shoulder level) has already been studied and found to be moderate.[11] The questions on the postures were included only in the 1992 and 1994 questionnaire. Because changes between 1992 and 1994 were reported by less than 25% of the subjects, we decided to use the 1992 values also for 1993 and the 1994 values also for 1995.
The non-respondents did not differ from the respondents for most explanatory variables. The only exception was self assessed ability to work, the non-respondents reporting about 1.5 times as often as the respondents that they will have difficulties at work during the coming 5 years due to musculoskeletal health.

STATISTICAL METHODS

There are three important generalized linear models for longitudinal data with repeated measurements: marginal models, transition models, and random effect models.[17] [18] In this study we applied the first two of these. Marginal models are appropriate when inferences about the population average are the focus. In most cases they are useful for epidemiological studies. In marginal models as well as marginal expectation of outcome, the correlation between the measurements can also be modeled. The marginal expectation is modeled in each assessment and the marginal regression coefficients have the same interpretation as those from a traditional cross sectional analysis. We used the generalized estimating equations method[19] [20] to fit the marginal models.

In the transition model the outcome can be predicted on the basis of explanatory variables and all available information of previous outcomes. In these models the correlation of the repeated observations is dealt with by treating previous outcomes as additional explanatory variables and by calculating robust variance estimates. An advantage of these models is that the interactions can also be tested between the previous outcome and the explanatory variables. Both marginal models and transition models can use all available information—that is, if a subject is dropped from the study, his or her earlier data can be used in the analysis.

The outcome variable was radiating neck pain with three levels (0-7, 8-30, >30 days). The explanatory variables were the physical load factors, work characteristics, and individual variables already listed. All explanatory variables except sex and age were time dependent. For some categorical variables, classes with small numbers were combined. Sum score variables were categorized. The effect of calendar time was also assessed. Interactions between physical load factors and work organizational factors, and physical load factors and selected individual factors (sex, age, body mass index, and mental stress) were of primary interest and were tested for when these variables were significant in the main effects model. Also interactions were tested between physical load factors and those between sex and age. With both methods, backward elimination strategy was used to construct the main effects model. Then, the interactions of interest between the variables in the main effects model were added to the model and the significant ones were included. A 5% level was considered to be significant.

Marginal model

In our longitudinal study we had repeated measurements from each person and therefore the correlation between them must be taken into account. In this analysis our main interest was in the marginal expectation, and the correlation was a nuisance. Moreover, the generalized estimating equations method gives consistent parameter estimates and their variances even if the correlation structure is mis-specified, given that the missing values generating mechanism is missing completely at random.[20] However, the better the specified correlation approximates the true correlation, the better is the efficiency of the parameter estimates. We chose an exchangeable correlation structure to describe the dependencies between the measurements, meaning that the correlation between the measurements was constant between the time lags. Robust variance estimates were used in the calculation of confidence intervals for the parameters. The generalized estimating equations method[19] in the SUDAAN program[21] was used to fit the proportional odds model to assess the effects of the explanatory variables on the ordered categorical outcome. The validity of the proportional odds assumption—that is, the homogeneity of the odds ratios across all possible cut off points of the response—was confirmed by fitting separate models with logit link function to both dichotomized responses with the same explanatory variables.

Transition model

In the Markov transition model (logistic model with proportional odds assumption) for longitudinal

data analysis,[19] the response in a previous questionnaire was included as an additional explanatory variable. We applied the first order Markov chain—that is, only the previous responses were used as explanatory variables. To ascertain a proper temporal relation between the exposures and the outcome, we lagged the exposures by 1 year. The 1992 exposures and outcome were used to predict the 1993 outcome, the 1993 exposures and outcome were used to predict the 1994 outcome, etc. S-Plus software with Design library was used.[22] The transition model was fitted with the lrm function of the Design library. Robust SEs of the parameter estimates were calculated with ROBCOV and ANOVA functions to test the significance. The pairwise interactions of primary interest already listed were studied. Moreover, interactions with the response from the previous year were of special interest, as such interactions suggest different effects for incident and persistent neck pain.

Results

In 1992, 67% of the subjects were healthy, 13% had mild, and 20% severe radiating neck pain (table 1). In 1995, the proportions of the healthy workers and those with mild pain were slightly higher and the proportion of those with severe pain was slightly lower.

Table 1 Radiating neck pain in 1992 and 1995

	1995							
	Healthy		*Mild*		*Severe*		*All*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
1992:								
Healthy (67%)	1562	85	170	9	118	6	1850	100
Mild (13%)	175	50	107	31	65	19	347	100
Severe (20%)	175	31	129	23	256	46	560	100
All (100%)	1912	69	406	15	439	16	2757	100

In the first questionnaire survey in 1992, radiating neck pain showed associations with sex, age, physically strenuous work, squatting or kneeling, forward flexion of the trunk, twisting of the trunk, working with a hand above shoulder level, mental strenuousness of work, balance of work demands, overload at work, body mass index, stress, and self assessed ability to work (table 2). The mean values for other musculoskeletal pains were 0.34 among healthy workers, 0.55 among those with mild, and 1.93 among those with severe radiating neck pain.

Table 2 Distributions of the subjects in the different categories of radiating neck pain

according to explanatory variables in 1992 (n=5180)

	Radiating pain					
	None		*Moderate*		*Severe*	
Explanatory variable	*n*	*%*	*n*	*%*	*n*	*%*
Sex:						
Male	2522	68	493	13	687	19
Female	673	55	199	16	355	29
Age (y):						
<35	860	76	154	14	110	10
35-44	1151	69	258	15	264	16
45-54	942	57	223	13	502	30
55-64	242	52	57	12	166	36
Physical strenuousness of work:						
Not at all	490	77	56	9	88	14
Rather light	906	69	203	15	207	16
Somewhat strenuous	999	64	218	14	336	22
Rather strenuous	502	57	136	16	235	27
Very strenuous	281	54	78	15	165	31
Squatting or kneeling at work (h/day):						
Not at all	1110	67	215	13	330	20
<0.5	1024	67	225	15	273	18
0.5-1	625	63	151	15	211	22
>1	417	58	96	13	209	29
Working with the trunk flexed forward (h/day):						
>1	1913	70	370	13	471	17
1-2	419	65	102	16	121	19
>2	830	57	210	14	424	29
Twisting movements of the trunk during a work day:						
Not at all	168	84	20	10	13	6
Little	1444	73	237	12	290	15
Moderate	1075	62	260	15	410	23
Much	498	50	172	18	320	32

Working with a hand above shoulder level (h/day):						
<0.5	1929	69	392	14	470	17
0.5-1	742	65	158	14	245	21
>1	490	53	134	14	304	33
Mental strenuousness of work:						
Not at all or rather light	1111	72	186	12	244	16
Somewhat strenuous	1463	63	336	15	502	22
Rather strenuous	512	59	139	16	222	25
Very strenuous	99	51	28	14	67	35
Balance of work demands:						
Good (score 2-4)	930	71	156	12	219	17
Moderate (score 5-6)	1600	64	381	15	511	21
Poor (score 7-10)	647	59	150	14	300	27
Overload at work:						
Not at all (score 2-4)	793	72	129	12	172	16
Little (score 5-6)	1779	65	391	14	565	21
Definite (score 7-10)	602	57	171	16	292	27
Body mass index (kg/m^2):						
<23.0	815	71	159	14	180	15
23.0-25.9	1195	67	235	13	362	20
26.0-28.9	738	61	189	15	288	24
≥29.0	403	59	96	14	189	27
Frequency of physical exercise (times/week):						
<2	1133	65	254	14	365	21
2-3	1198	65	256	14	390	21
>3	824	65	175	14	268	21
Smoking:						
Non-smoker	1314	66	283	14	390	20
Ex-smoker	859	64	205	15	287	21
Current smoker	1006	64	201	13	356	23
Mental stress:						
Not at all	853	79	87	8	139	13
Little	1269	67	267	14	355	19
To some extent	855	58	260	17	367	25
Much	203	45	74	16	173	39
Self assessed ability to work during the coming 5 years because of musculoskeletal health:						

No problems	2085	80	309	12	224	8
Problems possible	824	50	297	18	538	32
Problems likely	103	29	46	13	209	58

MARGINAL MODEL

The final proportional odds model fitted by the generalized estimating equations method is shown in table 3. The proportional odds assumption means that the odds ratios of the explanatory variables apply to all cut off points (at least mild radiating neck pain *v* healthy, severe *v* healthy or mild) of the response. The women had a 1.4-fold to 2.2-fold risk of radiating neck pain compared with men of the same age (table 4).

Table 3 Odds ratios for explanatory variables of radiating neck pain among Finnish forest industry workers in 1992-5 (marginal model fitted by generalized estimating equations method, n=5179)

	Radiating neck pain	
Explanatory variable	*OR*	*95% CI*
Constants for three level response:		
Intercept 1	0.02	0.01 to 0.03
Intercept 2	0.06	0.04 to 0.08
Time:		
1992	1.0	
1993	0.9	0.8 to 1.0
1994	1.1	1.0 to 1.2
1995	0.7	0.7 to 0.8
Sex:		
Male	1.0	
Female	1.4	1.0 to 1.8
Age (y):		
<35	1.0	
35-44	1.2	1.0 to 1.4
45-54	1.7	1.5 to 2.1
55-64	1.8	1.4 to 2.3
Amount of twisting movements of the trunk during a work day:		

Not at all	1.0	
Little	1.8	1.0 to 3.3
Moderate	2.9	1.6 to 5.2
Much	3.5	1.9 to 6.7
Working with a hand above shoulder level (h/day):		
<0.5	1.0	
0.5-1	3.4	1.5 to 7.5
>1	2.2	0.7 to 6.4
Balance of work demands:		
Good	1.0	
Moderate	1.2	1.0 to 1.3
Poor	1.2	1.0 to 1.3
Overload at work:		
Not at all	1.0	
Little	1.2	1.1 to 1.3
Definite	1.3	1.1 to 1.5
Body mass index (kg/m^2):		
<23.0	1.0	
23.0-25.9	1.1	1.0 to 1.3
26.0-28.9	1.4	1.2 to 1.7
≥29.0	1.5	1.2 to 1.7
Smoking:		
Non-smoker	1.0	
Ex-smoker	1.1	1.0 to 1.2
Current smoker	1.2	1.1 to 1.3
Mental stress:		
Not at all	1.0	
Little	1.5	0.8 to 3.0
To some extent	2.2	1.2 to 4.3
Much	6.4	3.1 to 13.0
Other musculoskeletal pains (sum score):		
Increment of one unit	2.3	2.2 to 2.4
Interactions:		
Sex×age (y):		
Male×<35	1.0	
Female×35-44	1.6	1.2 to 2.3
Female×45-54	1.2	0.9 to 1.7
Female×55-64	1.0	0.6 to 1.7

Twisting of the trunk×stress:		
Not at all×not at all	1.0	
Little×little	1.0	0.5 to 2.0
Little×to some extent	0.9	0.5 to 1.8
Little×much	0.4	0.2 to 0.8
Moderate×little	0.9	0.4 to 1.7
Moderate×to some extent	0.8	0.4 to 1.5
Moderate×much	0.4	0.2 to 0.8
Much×little	1.0	0.5 to 2.0
Much×to some extent	0.9	0.4 to 1.8
Much×much	0.3	0.2 to 0.7
Twisting of the trunk×working with a hand above shoulder level (h/day):		
Not at all×<0.5	1.0	
Little×0.5-1	0.4	0.2 to 0.9
Little×>1	0.8	0.3 to 2.5
Moderate×0.5-1	0.3	0.2 to 0.8
Moderate×>1	0.6	0.2 to 1.8
Much×0.5-1	0.3	0.1 to 0.6
Much×>1	0.6	0.2 to 1.7

Table 4 Effect (odds ratio) of sex on radiating neck pain in different age groups

	Age (y)			
	<35	*35-44*	*45-54*	*55-64*
Sex:				
Men (reference)	1.0	1.0	1.0	1.0
Women	1.4	2.2	1.7	1.4

The effect of age on radiating neck pain was higher among the women than among the men. Among the men the risk of neck pain increased after the age of 45. Among the women the risk of neck pain

increased after the age of 35 (table 5).

Table 5 Effect (odds ratio) of age on radiating neck pain according to sex

	Sex	
	Men	*Women*
Age (y):		
<35 (reference)	1.0	1.0
35-44	1.2	2.0
45-54	1.7	2.2
55-64	1.8	1.9

The risk of radiating neck pain increased with increasing amount of twisting movements of the trunk. The effect of the amount of twisting movements of the trunk was dependent on working with a hand above shoulder level and stress. The effect was highest for those working with a hand above shoulder level for less than 0.5 hours a day and lowest for those working with a hand above shoulder level for 0.5-1 hours a day. The effect of the amount of twisting movements decreased with increasing amount of stress.

The risk of radiating neck pain increased with increasing duration of working with a hand above shoulder level, except for those with no twisting movements of the trunk (table 6). The risk of radiating neck pain increased slightly with moderate or poor balance of work demands and overload at work.

Table 6 Effect (odds ratio) of working with a hand above shoulder level on radiating neck pain according to amount of twisting movements of the trunk

	Amount of twisting movements of the trunk			
	Not at all	*Little*	*Moderate*	*Much*
Working with a hand above shoulder level (h/day):				
<0.5 (reference)	1.0	1.0	1.0	1.0
0.5-1	3.4	1.3	1.1	0.9
>1	2.2	1.8	1.3	1.2

Body mass index had an effect on radiating neck pain; subjects with an index above 26.0 kg/m^2 had a 1.4-fold to 1.5-fold risk compared with those with an index below 23.0 kg/m^2. Smokers had a slightly increased risk of radiating neck pain.

Mental stress had a strong effect on radiating neck pain. Among the subjects with no twisting movements of the trunk those with much stress had a sixfold risk of neck pain compared with those with no stress. The risk was twofold among those with at least little twisting movements. Other musculoskeletal pains markedly increased the risk of radiating neck pain.

TRANSITION MODEL

Previous radiating neck pain was a strong predictor of current pain (table 7). It had an interaction with working with a hand above shoulder level. Among those who worked with a hand above shoulder level less than 0.5 hours a day, mild radiating pain in a previous questionnaire increased the risk of current pain fivefold, and previous severe radiating pain increased the risk almost 10-fold. For those who worked with a hand above shoulder level more than 0.5 hours a day these effects were lower (table 8).

Table 7 Odds ratios for explanatory variables of radiating neck pain among Finnish forest industry workers in 1992-5 (transition model, n=3994 subjects (8856 transitions))

	Radiating neck pain	
Explanatory variable	*OR*	*95% CI*
Constants for three level response:		
Intercept 1	0.06	0.05 to 0.08
Intercept 2	0.02	0.02 to 0.02
Previous radiating neck pain (days during preceding 12 months):		
0-7	1.0	
8-30	5.3	4.5 to 6.3
>30	9.5	7.8 to 11.6
Time:		
1992	1.0	
1993	0.9	0.8 to 1.0
1994	0.6	0.6 to 0.7
Sex:		
Male	1.0	
Female	1.4	1.2 to 1.6
Age (y):		
<35	1.0	
35-44	1.4	1.2 to 1.6

45-54	1.7	1.4 to 1.9
55-64	1.4	1.1 to 1.8
Working with the trunk in forward flexion (h/day):		
<1	1.0	
1-2	1.2	1.0 to 1.3
>2	1.2	1.0 to 1.3
Working with a hand above shoulder level (hours/day)		
<0.5	1.0	
0.5-1	1.2	1.0 to 1.5
>1	1.6	1.3 to 2.0
Body mass index (kg/m^2):		
<23.0	1.0	
23.0-25.9	1.0	0.9 to 1.1
26.0-28.9	1.2	1.0 to 1.4
≥29.0	1.3	1.1 to 1.5
Smoking:		
Non-smoker	1.0	
Ex-smoker	1.2	1.0 to 1.3
Current smoker	1.1	1.0 to 1.3
Mental stress:		
Not at all	1.0	
Little	1.3	1.1 to 1.5
To some extent	1.5	1.3 to 1.8
Much	1.7	1.4 to 2.0
Other musculoskeletal pains (sum score):		
Increment of one unit	1.4	1.3 to 1.5
Self assessed ability to work during the coming 5 years because of musculoskeletal health:		
No problems	1.0	
Problems possible	1.5	1.4 to 1.7
Problems likely	2.0	1.6 to 2.5
Interaction		
Radiating neck pain in a previous questionnaire (days)×working with a hand above shoulder level (h/day):		
<8×<0.5	1.0	

8-30×0.5-1	0.8	0.6 to 1.2
8-30×>1	0.8	0.6 to 1.1
>30×0.5-1	0.6	0.4 to 0.8
>30×>1	0.7	0.5 to 0.9

Table 8 Effect (odds ratio) of radiating pain in a previous questionnaire on current radiating pain by working with hand above shoulder level

	Working with a hand above shoulder level (h/day)		
	<0.5	*0.5-1*	*>1*
Radiating pain in a previous questionnaire (days/12 months):			
0-7 (reference)	1.0	1.0	1.0
8-30	5.3	4.3	4.2
>30	9.5	5.7	6.6

The risk of radiating neck pain was higher among the women than among the men. The risk of radiating neck pain increased with increasing age until 45-54 years and decreased slightly in the oldest age group.

Working with the trunk in forward flexion slightly increased the risk of radiating neck pain.

Working with a hand above shoulder level increased the risk of radiating neck pain only among those who had not had previous radiating neck pain (table 9).

Table 9 Effect (odds ratio) of working with a hand above shoulder level on radiating pain according to radiating pain in a previous questionnaire

	Radiating pain in a previous questionnaire (days/12 months)		
	0-7	*8-30*	*>30*

Working with a hand above shoulder level (h/day):			
<0.5 (reference)	1.0	1.0	1.0
0.5-1	1.2	1.1	1.0
>1	1.6	1.0	1.1

High body mass index and smoking increased the risk of radiating neck pain slightly. There was a dose-response relation between mental stress and radiating neck pain. A one unit increase in other musculoskeletal pains increased the risk of radiating neck pain 1.4-fold. Those anticipating problems in future ability to work had an increased risk of radiating neck pain.

Discussion

In our longitudinal study, we found that radiating neck pain was associated with some physical work load factors and several individual factors. We chose radiating pain as the outcome in our study, because we found that radiating neck pain was a more persistent symptom than local neck pain (data not shown). Moreover, we found in an earlier analysis that the risk estimates were higher for several factors when radiating neck pain was used as the outcome compared with local neck pain.[15]

Two methods of statistical analysis were used. The transition model was used in a predictive analysis by lagging the exposures by 1 year. The inclusion of the outcome from the previous year as an explanatory variable also enabled us to test for the interactions between previous radiating pain and the exposures of interest. For the proportional odds model run by the generalized estimating equations method we chose the outcome and the explanatory variables from the same year. The reason for this was that we assumed some of our explanatory variables—for example, mental stress and other musculoskeletal pains—have fairly short term effects. Also the exposures to physical work load were assumed to have short term effects as well as long term effects. Moreover, having the exposure and outcome from the same year enabled us to use all our data in the analysis. We used multiplicative models; however, the interactions found suggested that some joint effects of the variables might be additive.

The risk of radiating neck pain was slightly higher for women than for men. This agrees with earlier studies[3] and can be explained by biological factors—for example, lower force of the shoulder muscles among women. The variable, sex, can also entail work exposure factors that were not assessed in the study.

Higher age increased the risk of neck pain in both analyses of this study. In the model fitted by the generalized estimating equations method age had an interaction with sex, but in the transition model age had an independent effect on neck pain. The risk of radiating neck pain increased until the age of 55 and decreased slightly thereafter. The increase with age can be understood by increasing degeneration of the cervical spine with age. The decrease of radiating neck pain in the oldest age group is more difficult to explain. There was no selection out of the cohort according to age, neither was there selection according to previous radiating neck pain. One explanation could be that with advanced degenerative changes the spine restabilises and may become less painful.

Working with a hand above shoulder level was associated with radiating neck pain both in the model based on generalized estimating equations and the transition model. In the transition model there was, however, an interaction with previous radiating neck pain, indicating an increasing risk with increasing duration of such work only among the workers with healthy necks (incident neck pain). Working with a hand above shoulder level did not predict the persistence of radiating neck pain. Feedback bias (that subjects with neck pain may with time modify their work load,[18] in this case working with a hand above shoulder level) may explain this finding.

The amount of twisting movements of the trunk was fairly strongly associated with radiating neck pain in the model based on generalized estimating equations, but not in the transition model. Also the balance of work demands was associated with radiating neck pain only in the model fitted by the generalized estimating equations method.

Most of the questions about work load had already been validated at the workplace.[11] For some work postures we found that those with severe low back pain tended to overestimate the duration of the posture. If this holds true for radiating neck pain, the odds ratios for the postural factors may be somewhat overestimated in the model based on generalized estimating equations.

The result that the subjects reported less radiating neck pain in the 3rd year of follow up than in the preceding questionnaires was somewhat unexpected, as they were then 3 years older than in the beginning of the follow up. It is possible that the 3 year follow up period was too short to show an effect of aging.

Body mass index was associated with radiating neck pain. Similar results were obtained in a Finnish normal population study in which clinically defined "chronic neck syndrome" was associated with body mass index.[3] Biomechanical factors may explain the result to some extent. Metabolic factors might also be involved, as obesity has been associated with general osteoarthrosis.[23]

Smoking was weakly associated with radiating neck pain. Leino-Arjas showed in a 10 year prospective study that smoking predicted a change in neck and shoulder symptoms score, consisting of non-specific symptoms in the neck and shoulders and radiating neck pain.[24]

Mental stress was associated with radiating neck pain in both analyses, and it was an independent predictor in the transition model. To our knowledge this is the first prospective study to show evidence of mental stress as a predictor of neck symptoms. In an earlier study with four repeated questionnaire surveys carried out at 3 month intervals we saw a concurrent occurrence between neck symptoms and mental stress.[25] Leino and Hänninen found that the sum score of "overstrain" (composed of mental strenuousness of work, extent of work concerns at home, and being overstrained by work) predicted the 10 year change in the 12 month score of symptoms of the neck, shoulder, and upper limbs among white collar men in the metal industry.[13] In a previous report, Leino found that stress symptoms predicted musculoskeletal disorders 5 and 10 years later.[26] Neck symptoms or disorders were not analyzed separately in these studies. In a 24 year follow up study, high mental work load at the onset of the study was associated with disorders of the neck and shoulder region at the end of the follow up. Temporal relations remain obscure, as neck disorders were not assessed in the beginning of the study, and the follow up time was very long.[27] The effect of stress is usually explained as being mediated through increased awareness and muscle tension.

Other musculoskeletal pains increased the risk of radiating neck pain. Similar musculoskeletal comorbidity has earlier been reported in cross sectional studies.[3 28] Such comorbidity is best understood

by common risk factors of the disorders, or their common pathomechanisms—such as degeneration—but other factors may also play a part.

Those anticipating problems in future ability to work because of musculoskeletal health had an increased risk of radiating neck pain in the transition model. This result shows the significance of subjective assessments in the prediction of health outcomes.

The lack of association between radiating neck pain and physical exercise is in agreement with some other studies.[29 30] In a prospective study, Pietri-Taleb *et al* found that physical exercise at least twice a week protected against neck trouble.[6]

Whether the subjects were working or not in the target enterprise at the time of the follow up assessments had no effect on radiating neck pain. In this study, most of those who were no longer employed by the enterprise were from the two oldest groups and were retired. Our result suggests that leaving work had no effect on radiating neck pain. Studies with workers in highly repetitive or static tasks have shown a decrease in neck disorders or symptoms after a major change in workload.[1 31]

The effects of some of the explanatory variables on the risk of radiating neck pain were small in this study. This reflects the multifactorial nature of radiating neck pain. The strong effect of previous radiating neck pain shows the chronic nature of this symptom. Previous pain may also reflect earlier effects of the other risk factors.

Our results suggest that more individual factors than work related factors are associated with radiating neck pain. This result may be partly due to a greater accuracy of some of the individual factors. Factors such as sex, age, and body mass index involve almost no error, whereas the assessment of the duration of certain work postures each day is only moderately valid at best. Error in the assessment of exposure usually attenuates the effect.

The response rates to the four questionnaires were fairly high. Yet, those who replied to all four questionnaires represented only 43% of the originally selected cohort of 7000 subjects. We think that it is difficult to achieve higher response rates in this type of repeated measurements study. We judged that we could not send questionnaires to the subjects who had not replied to the previous questionnaire after two reminders.

To see how our study population might have been selected we compared the outcome and the explanatory variables from the previous year between the respondents and non-respondents. We found no differences in radiating neck pain and only minor differences in age and sex distribution, and leaving versus continuing employment. Yet the non-respondents more often anticipated difficulties at work during the coming 5 years than the respondents due to musculoskeletal health, suggesting that there might have been some health based selection in our study population. This may have violated the missing completely at random requirement in our analyses and caused some bias to our estimates.

It is concluded that, of factors amenable to change, working with a hand above shoulder level, mental stress, being overweight, and smoking were consistently associated with radiating neck pain. Measures to prevent workers from being overweight should therefore be directed to both physical work load factors and factors that may cause stress. Prevention of being overweight may reduce neck pain as well as its other beneficial effects. Radiating neck pain is a persistent symptom and often coexists with other musculoskeletal symptoms.

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Risk factors for incident neck and shoulder pain in hospital nurses

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ABSTRACT

Aim: To assess the incidence and risk factors for neck and shoulder pain in nurses.

Methods: A longitudinal study of neck and shoulder pain was carried out in female nurses at two hospitals in England. Personal and occupational risk factors were assessed at baseline. The self reported incidence of symptoms in the neck and shoulder region was ascertained at three-monthly intervals over two years. A Cox regression model was used to estimate hazard ratios (HRs) for incident neck/shoulder pain during follow up in nurses who had been pain free for at least one month at baseline.

Results: The baseline response rate was 56%. Of 903 women who were pain free at baseline, 587 (65%) completed at least one follow up while still in the same job. During an average of 13 months, 34% of these (202 women) reported at least one episode of neck/shoulder pain. The strongest predictor of pain in the neck/shoulder was previous history of the symptom (HRs up to 3.3). For physical exposures at work, the highest risks (HRs up to 1.7) were associated with specific patient handling tasks that involved reaching, pushing, and pulling. Nurses who reported low mood or stress at baseline were more likely to develop neck/shoulder pain later (HR 1.5). Workplace psychosocial factors (including job demands, satisfaction, and control) were not associated with incident neck/shoulder symptoms.

Conclusions: Neck/shoulder pain is common among hospital nurses, and patient handling tasks that involve reaching and pulling are the most important target for risk reduction strategies.

Abbreviations: CI, confidence interval; HR, hazard ratio

Hospital nurses have a high prevalence of low back pain,[1–4] and the risk of low back disorders from physical activities in patient care has been the focus of extensive research.[1–12] In comparison, relatively few studies have explored the influence of patient handling on neck and shoulder pain,[8–10,12–14] and most of these have been cross sectional in design.[9,10,12–14]

As part of a prospective investigation to assess the impact of an ergonomic intervention on musculoskeletal symptoms, we collected longitudinal data on the occurrence of neck and shoulder pain in a cohort of nurses. We here present an analysis of the risk of incident neck/shoulder pain in relation to personal and occupational risk factors ascertained at baseline.

METHODS

The study was carried out at two similar acute hospitals in the south of England, both of which provided in-patient care across a range of clinical specialties other than mental health. From personnel records, we identified all nurses employed by these hospitals, excluding agency staff, student nurses, and those who worked in community roles. Each nurse was sent a baseline postal questionnaire, followed if necessary by a reminder after six weeks. Among other things, the questionnaire asked about the following: age; sex; height; weight; details of current occupation; frequency of exposure to various common nursing activities (with and without assistance from colleagues or mechanical aids); perceived psychosocial aspects of work, including job demand and satisfaction; experience of non-musculoskeletal symptoms including low mood and stress; and history of pain in the neck and/or shoulders. Questions about psychosocial stressors in the workplace were taken from the Whitehall II study,[15] and were used to derive a score in relation to each of five aspects of work: demand, interest, control, support, and satisfaction. For analysis, these scores were partitioned into thirds (low, intermediate, and high). Questions about workplace activities and experience of non-musculoskeletal

symptoms were based on a questionnaire that had been used previously to study occupational risk factors for low back pain in hospital nurses.[5] Neck/shoulder pain was defined as pain lasting for longer than a day in an anatomical distribution bounded by the occiput and the lower edges of the scapulae that was illustrated with a diagram (fig 1). It was ascertained through a question derived from the Nordic Musculoskeletal Questionnaire.[16]

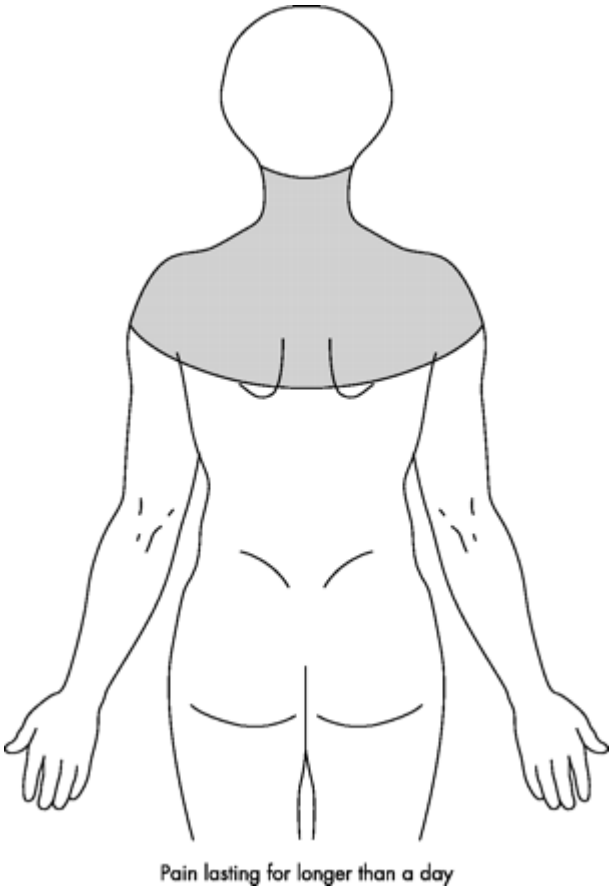

Figure 1 Definition of neck/shoulder pain.

Subjects who responded to the baseline questionnaire were asked whether they would take part in a subsequent longitudinal phase of data collection, and those who agreed were sent shorter follow up questionnaires at three-monthly intervals over the next two years. The follow up questionnaire included sections about new neck/shoulder pain since the previous contact and about any changes in occupation. Nurses who did not respond to a follow up questionnaire were sent a reminder and were included in the next follow up. Those who failed to respond to two consecutive three-monthly questionnaires were dropped from further follow up.

The main analysis presented in this paper was restricted to female nurses who had been free from pain in the neck or shoulder for at least one month at baseline, and who completed at least one follow up questionnaire while still in the same job as when they entered the study. Cox regression was used to calculate the risk of incident neck/shoulder pain during follow up according to both occupational and non-occupational factors measured at baseline. Risk estimates were summarized as hazard ratios (HRs)

with 95% confidence intervals (CIs). Where a nurse changed her job during the longitudinal phase of the study, follow up was censored after the last questionnaire that preceded the change.

Main messages

Neck/shoulder pain is less common than low back pain in nurses, but is nevertheless an important cause of morbidity and sickness absence.

Of the occupational risk factors studied, physical activities were more strongly associated with neck/shoulder pain than psychosocial variables. Physical tasks that required pulling or pushing with the outstretched arm/shoulder carried the highest risk of neck and shoulder symptoms.

Previous history of neck/shoulder pain is a stronger predictor of future symptoms than any occupational exposure.

Although the investigation was conceived as an intervention study, the intervention (which included the introduction of new equipment and training at one of the two hospitals) did not begin until 18 months after the start of follow up. Moreover, when nurses' patterns of work were reassessed 14 months later, there appeared to have been little change at either hospital.[16a] Therefore, when analyzing risk factors for incident neck pain, we did not try to take account of changes in activities over the course of follow up in nurses who remained in the same job.

RESULTS

The study population comprised 2200 nurses. The baseline survey was returned by 1239 subjects (56% of those mailed) who had an age and sex distribution similar to that of the study population as a whole. An initial descriptive analysis[17] confirmed that nurses in the two hospitals were similar in age, and exposure to physical and psychosocial factors at work.

Policy implications

Handling equipment designed to reduce the risk of back pain (particularly slide sheets) might increase nurses' exposure to pulling and reaching. More research is needed to explore this further. Meanwhile, ergonomic interventions in hospitals should include consideration of the risk of symptoms in the neck and shoulder as well as low back pain.

Job changes or redeployment might be considered for nurses with a recent or prolonged previous history of neck/shoulder pain or low back pain, but only if the risk remains high after

optimal management of physical exposures at work.

Nineteen responders were excluded from further analysis because they reported working in midwifery or non-nursing jobs. Of those who remained, 1157 were women. The age of these women ranged from 19 to 67 years with a mean age of 39 years. Approximately half worked full time, 19% were healthcare assistants, and 76% were qualified nurses of staff nurse level (D grade) or higher. Forty nine per cent reported that they had suffered from neck/shoulder pain at some time in their life, 35% in the past year, and 22% in the past month. Twenty seven per cent had taken time off work because of neck/shoulder pain at some stage in their careers.

Nine hundred and three nurses indicated that they had not experienced pain in the neck or shoulder during the month before answering the baseline questionnaire. Among these, 613 women (68%) answered at least one three-monthly questionnaire, but 26 of these had changed their job before the first follow up. Our analysis of incident symptoms focused on the remaining 587 women. Table 1 summarizes the extent of follow up among these 587, of whom 190 stayed under follow up until the end of the study. The remaining nurses were censored from analysis if they changed job (n = 68) if they developed neck/shoulder pain, or if they failed to return two successive questionnaires.

Table 1 Extent of follow up among female nurses who were free from neck/shoulder pain at baseline

Follow up time point	Number of nurses still under follow up	Number reporting neck/shoulder pain for the first time	Number censored due to job change	Number lost to follow up
1	587	81	9	45
2	452	43	3	47
3	359	26	7	20
4	306	18	4	19
5	265	11	7	10
6	237	9	4	8
7	216	10	4	12
8	190	4	–	186

Among the 587 female nurses in the longitudinal analysis, 202 (34%) reported at least one episode of pain in the neck or shoulder during an average follow up period of 13 months. Table 2 shows the risk

of incident neck/shoulder pain by age, height, and body mass index. There was no indication that risk varied importantly with height. Weak associations with increasing age and body mass index were not statistically significant.

Table 2 Risk of incident neck/shoulder pain according to age, height, and body mass index (BMI)

Risk factor	Number of nurses*	Cases of neck/shoulder pain Number (%)	Hazard ratio (95% CI)
Age at baseline (years)			
<30	105	31 (30)	1
30–39	221	74 (33)	1.1 (0.7 to 1.6)
40–49	153	55 (36)	1.2 (0.8 to 1.8)
⩾50	103	42 (41)	1.4 (0.9 to 2.3)
			p_{trend}=0.1
Height (cm)			
<160	139	50 (36)	1
160–164.9	157	56 (36)	1.0 (0.7 to 1.4)
165–169.9	164	53 (32)	0.8 (0.6 to 1.2)
⩾170	124	43 (35)	0.9 (0.6 to 1.3)
BMI (kg/m^2)			
<25	352	119 (34)	1
25–29.9	152	54 (36)	1.1 (0.8 to 1.5)
⩾30	66	26 (39)	1.3 (0.9 to 2.1)
			p_{trend}=0.2

*Data were missing for up to 17 subjects.

At baseline, 208 nurses from the longitudinal analysis had reported that they frequently felt tired, low, tense, or under stress. After adjustment for age and BMI, the risk of incident neck/shoulder pain was

significantly increased in these women (HR 1.5, 95% CI 1.2 to 2.1). All subsequent analyses were adjusted for the occurrence of these psychological symptoms as well as for age and BMI.

Although all of the women included in the longitudinal analysis were free from neck and shoulder pain at baseline, some of them had experienced musculoskeletal symptoms previously. Table 3 presents the risk of incident neck/shoulder pain during follow up according to past history of musculoskeletal pain at baseline. Incidence increased with longer total duration of previous neck/shoulder pain and with decreasing interval since the last episode. The risk of new neck/shoulder pain was particularly high among nurses who reported previous neck/shoulder pain that had lasted for longer than four weeks in total and that had last occurred within the year before answering the baseline questionnaire (HR 3.3, 95% CI 1.9 to 5.8). A similar pattern of increased incident neck/shoulder pain was seen in nurses who reported a past history of low back pain at baseline. Although the risk estimates were somewhat lower than for previous history of neck/shoulder symptoms, low back pain was more common among this population of nurses than neck/shoulder pain (lifetime prevalence 59% compared to 36%). The attributable proportion in relation to lifetime experience of symptoms (HR 1.9 for low back pain and 2.1 for neck/shoulder pain) was higher for low back pain (31%) than for neck/shoulder pain (20%).

Table 3 Risk of incident neck/shoulder pain according to previous history of musculoskeletal pain at baseline

Previous musculoskeletal pain	Number of nurses*	Cases of neck/shoulder pain during follow up Number (%)	Hazard ratio† (95% CI)
Neck/shoulder pain			
Interval since last neck pain			
Never	355	99 (28)	1
>1 year ago at baseline	101	42 (42)	1.6 (1.1 to 2.3)
Within the past year at baseline	99	54 (55)	2.8 (2.0 to 3.9)
			p_{trend}<0.001
Total duration of previous neck pain			
Never	355	99 (28)	1
<1 week	80	31 (39)	1.7 (1.1 to 2.5)
1–4 weeks	64	35 (55)	2.3 (1.5 to 3.3)
>4 weeks	55	29 (53)	2.6 (1.7 to 4.0)
			p_{trend}<0.001
>4 weeks and pain within past year (compared to never had pain)	29	16 (55)	3.3 (1.9 to 5.8)

Low back pain			
Interval since last back pain			
Never	222	54 (24)	1
>1 year ago at baseline	111	46 (41)	1.8 (1.2 to 2.7)
Within the past year at baseline	221	95 (43)	1.9 (1.4 to 2.7)
			p_{trend}<0.001
Total duration of previous back pain			
Never	222	54 (24)	1
<1 week	76	25 (33)	1.4 (0.9 to 2.3)
1–4 weeks	109	46 (42)	1.8 (1.2 to 2.7)
>4 weeks	144	70 (49)	2.3 (1.6 to 3.3)
			p_{trend}<0.001
>4 weeks and pain within past year (compared to never had pain)	107	55 (51)	2.6 (1.8 to 3.9)

*Data were missing for up to 36 nurses.

†Adjusted for age, BMI, and frequently feeling tired, low, tense, or under stress.

Table 4 shows the risk of incident neck/shoulder pain according to psychosocial aspects of work assessed at baseline. Hazard ratios were generally close to unity, and no clear trends were apparent with respect to reported job demands, interest, control, support at work, or job satisfaction.

Table 4 Risk of incident neck/shoulder pain according to psychosocial factors at work

	Number of nurses*	Cases of neck/shoulder pain Number (%)	Hazard ratio† (95% CI)
Demand			
Low	155	53 (34)	1
Intermediate	216	77 (36)	1.0 (0.7 to 1.4)

High	177	62 (35)	0.9 (0.7 to 1.4)
Interest			
High	203	67 (33)	1
Intermediate	186	63 (34)	1.1 (0.8 to 1.5)
Low	160	62 (39)	1.2 (0.9 to 1.8)
Control			
Low	190	70 (37)	1
Intermediate	200	63 (32)	0.9 (0.6 to 1.3)
High	157	58 (37)	1.1 (0.8 to 1.6)
Support			
High	182	67 (37)	1
Intermediate	202	67 (33)	0.9 (0.6 to 1.2)
Low	125	46 (37)	0.9 (0.6 to 1.3)
Satisfaction			
Low	160	49 (31)	1
Intermediate	224	86 (38)	1.3 (0.9 to 1.8)
High	150	50 (33)	1.2 (0.8 to 1.8)

*Data were missing for up to 41 nurses.

†Adjusted for age, BMI, and frequently feeling tired, low, tense, or under stress.

Table 5 presents the risk of incident neck/shoulder pain in relation to patient handling tasks carried out without the assistance of nursing colleagues or mechanical aids. There was a clear increase of risk in nurses who frequently assisted patients to mobilize using a walking stick, Zimmer frame, or crutches (HR for highest versus lowest frequency 1.6, 95% CI 1.1 to 2.3); moved patients in a wheelchair, bed, hoist, trolley, or commode (HR for highest versus lowest frequency 1.6, 95% CI 1.1 to 2.4); or washed and dressed patients while they were seated on a chair or commode (HR for highest versus lowest frequency 1.7, 95% CI 1.1 to 2.8). Several other activities were associated with smaller increases in risk that were not statistically significant. The tasks that were associated with a significantly high risk of incident neck and shoulder pain (HR $\geqslant$1.5 and $p < 0.05$ for the highest frequency category) were used to calculate the attributable proportion of symptoms due to physical work. Forty two per cent of nurses who reported new neck/shoulder pain during follow up had carried out at least one of these four high risk activities (assist a patient to mobilize using a walking stick, Zimmer frame, or crutches; move a patient around in a wheelchair, bed, hoist, trolley, commode, etc; wash/dress a patient while they are on

a chair or commode and wash/dress a patient while they are on their bed). The attributable proportion for carrying out one or more of these activities more than five times per shift (versus not carrying out any of them more than five times per shift) was 22%.

Table 5 Risk of incident neck/shoulder pain according to frequency of unaided patient handling activities

Work activity*	Frequency per shift	Number of nurses†	Cases of neck/shoulder pain during follow up Number (%)	Hazard ratio (95% CI)‡
Assist patient to move from lying to sitting or from sitting to lying	0	171	50 (29)	1
	1–4	214	80 (37)	1.3 (0.9 to 1.8)
	≥5	112	43 (38)	1.4 (0.9 to 2.1)
Reposition a patient who has slumped sin a chair	0	347	115 (33)	1
	≥1	144	57 (40)	1.3 (0.9 to 1.8)
Assist a patient to mobilize using a walking stick, Zimmer frame, or crutches	0	217	65 (30)	1
	1–4	197	75 (38)	1.4 (1.0 to 1.9)
	≥5	113	47 (42)	1.6 (1.1 to 2.3)§
Move a patient around in a wheelchair, bed, hoist, trolley, commode, etc	0	158	48 (30)	1
	1–4	229	78 (34)	1.2 (0.8 to 1.7)
	≥5	122	54 (44)	1.6 (1.1 to 2.4)§
Assist a patient to sit up from a lying position	0	177	55 (31)	1
	1–4	203	73 (36)	1.2 (0.9 to 1.8)
	≥5	109	43 (39)	1.3 (0.9 to 1.9)
Assist a patient to move up/down the bed	0	241	85 (35)	1
	1–4	165	47 (28)	0.8 (0.5 to 1.1)

	≥5	85	35 (41)	1.1 (0.8 to 1.7)
Reposition (turn or roll) a patient	0	311	105 (34)	1
	1–4	135	43 (32)	1.0 (0.7 to 1.4)
	≥5	40	19 (48)	1.5 (0.9 to 2.4)
Transfer a patient in/out of a bath	0	425	140 (33)	1
	≥1	94	40 (43)	1.4 (1.0 to 2.0)
Wash/dress a patient while they are on a chair/commode	0	305	103 (34)	1
	1–4	171	60 (35)	1.1 (0.8 to 1.5)
	≥5	54	25 (46)	1.7 (1.1 to 2.8)§
Wash/dress a patient while they are on an ambulift/hoist	0	479	167 (35)	1
	≥1	36	13 (36)	1.1 (0.6 to 1.9)
Wash/dress a patient while they are on their bed	0	260	85 (33)	1
	1–4	194	66 (34)	1.1 (0.8 to 1.5)
	≥5	60	27 (45)	1.6 (1.0 to 2.5)

*Performed without handling aids and without assistance from colleagues.

†Data were missing for up to 69 nurses.

‡Adjusted for age, BMI, and frequently feeling tired, low, tense, or under stress.

§Test for trend, $p<0.05$.

Table 6 shows the risk of incident neck/shoulder pain according to the number of different unaided patient handling tasks carried out in an average working shift. In this analysis, attention was restricted to the eight activities from table 5 that showed the strongest associations with symptoms when

examined separately. Risk tended to increase with the number of tasks performed, although the trend was not statistically significant.

Table 6 Risk of incident neck/shoulder pain according to number of different unaided patient handling activities performed in an average shift

Number of activities performed unaided*	Number of nurses	Cases of neck/shoulder pain during follow up Number (%)	Hazard ratio† (95% CI)
0	43	15 (35)	1
1–2	57	17 (30)	1.1 (0.6 to 2.2)
3–4	82	21 (26)	0.8 (0.4 to 1.6)
5–6	98	31 (32)	1.1 (0.6 to 2.0)
7	113	41 (36)	1.3 (0.7 to 2.3)
8	93	36 (39)	1.5 (0.8 to 2.8)
			p_{trend}=0.09

*The activities considered were: (a) assisting a patient to move from lying to sitting or sitting to lying; (b) assisting a patient to mobilize using a walking stick, Zimmer frame, or crutches; (c) moving a patient around on a wheelchair, bed, hoist, trolley, commode, etc; (d) assisting a patient to sit up from a lying position; (e) repositioning (turning or rolling) a patient; (f) transferring a patient in/out of a bath; (g) washing/dressing a patient while they are on a chair/commode; and (h) washing/dressing a patient while they are on a bed.

†Adjusted for age, BMI, and frequently feeling tired, low, tense, or under stress.

DISCUSSION

In this longitudinal study, the strongest predictor of incident neck/shoulder pain was previous history of the symptom. Incidence also appeared to be influenced importantly by psychological morbidity (low mood and feeling stressed) and by a number of patient handling tasks commonly carried out by nurses, although the latter differed from those that have been associated with low back pain. In contrast to physical activities, workplace psychosocial factors had little impact on risk.

The investigation was designed to assess the impact of ergonomic improvements and training on musculoskeletal symptoms and disability by comparing the two participating hospitals before and after one of them implemented a planned intervention. However, because of practical difficulties, the intervention did not begin until 18 months after the start of data collection. Moreover, its impact on patient handling, at least over the next 14 months, was only slight.[16a] Therefore, we think it unlikely that major changes occurred in the occupational activities of our cohort of nurses over the course of

follow up. Nor was there any important reorganization of services at either hospital during the course of the study.

The scope for change in occupational activities was probably greatest where a nurse moved to a new job, and for this reason, we censored follow up before job transfers. It is possible that some participants moved from heavy work to positions that were physically less demanding because they were having problems with their neck. If so, the risks associated with patient handling activities could have been underestimated. However, in our experience, it would be unusual for such transfers to occur within three months of the onset of a new symptom episode.

Bias could also have arisen from the incomplete response to questionnaires. In particular, completion of the initial questionnaire may have been selectively higher in nurses with a history of neck trouble, in which case baseline estimates of prevalence will have been inflated. However, this would not affect associations with new episodes of pain during follow up.

One further methodological concern is the possibility that performance of certain physical activities made some nurses more aware of neck symptoms, and therefore more likely to report them. In the absence of objective diagnostic criteria, this problem is unavoidable. However, if the long term goal is to prevent distress and disability, factors that influence the awareness of symptoms are potential targets for intervention, and should not be regarded simply as a source of bias.

The one year and one month prevalences of neck/shoulder pain that we recorded at baseline (35% and 22%) were somewhat lower than those found in previous cross sectional surveys of nurses,[9,18,19] possibly because of differences in case definition. Nevertheless, the symptom was common, and had been a frequent cause of sickness absence (27% of subjects). This accords with the observation that in an Italian general hospital, 15% of sick leave among nurses was attributed to pain in the upper back and neck.[20]

Neck/shoulder pain was more likely to develop during follow up in nurses who at baseline reported being frequently tired, low, tense, or under stress. An association of neck and shoulder pain with depression, anxiety, and poor perceived health has been noted in several previous longitudinal investigations,[8,21,22] although not in all.[23] Importantly, these psychological symptoms were present at a time when subjects were free from neck/shoulder pain, which suggests that they did not occur as a consequence of underlying musculoskeletal disease. A more plausible explanation for the association is that anxiety and depression modify the central processing of sensory information, and so increase the distress caused by painful stimuli.

Our finding that previous neck/shoulder pain strongly predicts further occurrence of the symptom is consistent with other studies,[21,24] and indicates that like low back complaints,[5] neck and shoulder disorders have a marked tendency to recur. Previous low back pain also predicted new episodes of neck/shoulder pain. Moreover, because of the higher lifetime prevalence of low back pain, the attributable proportion of new neck/shoulder pain was higher for previous symptoms in the low back than in the neck/shoulder region. It appears that the risk of recurrent neck/shoulder pain is highest where previous musculoskeletal symptoms have been prolonged and have been present in the past 12 months. This is of practical relevance to pre-employment screening and also to the rehabilitation of workers after episodes of illness. Exclusion from a job could only be justified if the absolute risk of future illness was high and could not be satisfactorily reduced by modifications to the working environment and methods.

We found little evidence that psychosocial aspects of work influenced the development of neck/shoulder pain. An association with factors such as low support, high demands, and low decision latitude has been observed in several earlier studies of nurses.[12,13,19,25,26] Moreover, an interaction between physical and psychosocial factors at work has been suggested in relation to musculoskeletal symptoms in the upper limb.[27] Most of these investigations have been cross sectional, and the temporal relation between the workplace factors and symptoms is not clear.[9,13,16,25,26] However, the relation with psychosocial factors has also been found in longitudinal studies in nurses.[8,9,28] The absence of stronger associations in our study could reflect differences in the heterogeneity and severity of psychosocial stressors to which our cohort of nurses was exposed.

In comparison with psychosocial variables, we found that physical activities in the workplace were stronger predictors of incident neck/shoulder pain. Other investigators have reported an increased risk or severity of neck pain in relation to heavy lifting and uncomfortable posture,[26] physical stress at work,[29] working with the hands above shoulder height,[24,30–32] shoulder elevation, and neck flexion.[33–35] However, no previous studies have examined the incidence of neck pain in relation to specific nursing tasks. The risk of incident neck/shoulder pain increased modestly with increasing number of physical tasks, but a relatively high risk was associated with a very high number of tasks (>8). This is likely to reflect the fact that nurses caring for very dependent patients are frequently exposed to a variety of high risk activities and that these nurses are at particularly high risk.

We found that neck pain was associated particularly with helping patients to mobilize using a walking aid, moving patients around on a chair or commode, and washing patients when positioned in a chair. These tasks, which tend to involve reaching, pushing or pulling, differ from those that we have found previously to carry an increased risk of low back pain (mainly activities that entail lifting and loading of the spine such as manual bed to chair transfers and repositioning a patient on the bed).[5] The calculated attributable proportion suggests that up to 22% of nurses' neck and shoulder pain might be prevented by controlling exposure to pushing and pulling at work.

Our findings are in keeping with recent evidence that pushing and pulling is associated with a much higher risk of shoulder than low back complaints,[36] and with a small laboratory based study, which showed that the use of each of three different types of sliding aids (including a draw sheet and two different friction reducing devices) to move a volunteer "patient" up in bed was associated with a similar or higher perceived exertion to nurses' shoulder regions than to their lower backs.[37] This is of concern because it suggests that some of the equipment designed to reduce the risk of low back pain (for example, slide sheets) might lead to an increase in risk of neck and shoulder problems. We attempted to explore this further by comparing risk estimates for tasks carried out with sliding and handling devices and for the same tasks carried out manually or using hoists. However, this proved impossible because of the substantial overlap in exposure to patient handling with and without sliding aids and hoists.

Although there is now a substantial body of evidence linking musculoskeletal disease with patient handling tasks carried out by nurses, the effectiveness of control measures such as mechanical aids on musculoskeletal morbidity is still uncertain. In evaluating preventive strategies, it will be important to consider effects on neck and shoulder pain as well as on low back pain. Interventions that reduce low back pain may not be good for the neck, and could even be detrimental.

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Radiating Neck Pain
Examination

Select the *best* answer to each of the following items. Mark your responses on the Answer form.

1. There is evidence from both cross sectional and longitudinal studies that work with_____ increase the risk of various neck disorders.

a. abducted arms
b. forward flexion of the neck
c. repetitive movements of the hands or fingers
d. All of the above

2. Little is known about the _____, of the exposures associated with increased risk. To prevent neck disorders such information is necessary.

a. intensity
b. frequency
c. duration
d. All of the above

3. The quality of the assessment of physical load factors is essential in studies on musculoskeletal disorders. Objective measurements are considered more valid than subjective assessments.

a. True
b. False

4. Subjective assessment methods by questionnaire have been recently validated with studies showing that the questionnaire method is valid for some physical load factors at work—such as _____.

a. duration of sitting
b. walked distance
c. squatting or kneeling
d. All of the above

5. The problem with studies related to the neck is that we lack generally accepted diagnostic criteria for common neck disorders.

a. True
b. False

6. Physical load factors at work include _____.

a. Physical strenuousness of work (five categories
b. Squatting or kneeling at work (hours/day, four categories)
c. Amount of twisting movements of the trunk during a workday (four categories)
d. All of the above

7. Work characteristics studied included _____.

a. Mental strenuousness of work (five categories)
b. Overload at work (difficulty at work, hurry at work, scoring of both from 1 to 5, sum score variable)
c. Balance of work demands (influence on work, possibility to use knowledge and skills, scoring of both questions from 1 to 5, sum score variable)
d. All of the above

8. The outcome variable was radiating neck pain with three levels (0-7, 8-30, >30 days). The explanatory variables were _____.

a. physical load factors
b. work characteristics
c. individual variables
d. All of the above

9. In the study shown in the course, the women had a 1.4-fold to 2.2-fold risk of radiating neck pain compared with men of the same age.

a. True
b. False

10. The effect of age on radiating neck pain was higher among the women than among the men. Among the men the risk of neck pain increased after the age of_____. Among the women the risk of neck pain increased after the age of 35.

a. 40
b. 45
c. 50
d. 60

11. The risk of radiating neck pain increased with increasing amount of twisting movements of the trunk.

a. True
b. False

12. Of the occupational risk factors studied in the nurses' research, physical activities were more strongly associated with neck/shoulder pain than psychosocial variables. Physical tasks that required pulling or pushing with the outstretched arm/shoulder carried the highest risk of neck and shoulder symptoms.

a. True
b. False

13. The risk of radiating neck pain increased with increasing duration of working with a _____, except for those with no twisting movements of the trunk. The risk of radiating neck pain increased slightly with moderate or poor balance of work demands and overload at work.

a. a hand above shoulder level
b. a hand below shoulder level
c. a hand AT shoulder level
d. None of the above

14. Mental stress had a strong effect on radiating neck pain. Among the subjects with no twisting movements of the trunk those with much stress had a _____ of neck pain compared with those with no stress.

a. twofold
b. fourfold
c. sixfold risk
d. tenfold

15. High body mass index and smoking increased the risk of radiating neck pain slightly.

a. True
b. False

16. Neck/shoulder pain is common among hospital nurses, and patient handling tasks that involve reaching and pulling are the most important target for risk reduction strategies.

a. True
b. False

17. Neck/shoulder pain is less common than low back pain in nurses, but is nevertheless an important cause of morbidity and sickness absence.

a. True
b. False

18. Previous history of neck/shoulder pain is a stronger predictor of future symptoms than any occupational exposure.

a. True
b. False

19. Handling equipment designed to reduce the risk of back pain (particularly slide sheets) might increase nurses' exposure to pulling and reaching. More research is needed to explore this further. Meanwhile, ergonomic interventions in hospitals should include consideration of the risk of symptoms in the neck and shoulder as well as low back pain.

a. True
b. False

20. In the studies of nurses, in comparison with psychosocial variables, researchers found that physical activities in the workplace were stronger predictors of incident neck/shoulder pain.

a. True
b. False

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