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Musculoskeletal pain and discomfort and associated worker and organizational factors: A cross-sectional study

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Abstract.
BACKGROUND: Musculoskeletal disorders are a leading cause of work-related ill health, and a major cost burden for the individual, industry and the community. Despite the broad range of risk factors that have been identified, most studies have focused only on specific occupations or categories of risk factors, meaning that there is limited understanding of the relative contributions of individual and organisational, physical and psychosocial factors.
OBJECTIVE: This cross-sectional survey of workers in medium-to-large workplaces in South Australia sought to examine a broad range of factors within various workplaces and industries.
PARTICIPANTS: 404 workers from 29 workgroups and 23 separate companies participated in the research.
METHODS: Questionnaires were administered face-to-face, assessing demographic and job characteristics, safety climate, musculoskeletal pain and discomfort (MSPD) and job satisfaction. Potential predictors were grouped in terms of personal/job and organizational characteristics and associations with MSPD examined.
RESULTS: A considerable proportion of workers (40%) had experienced MSPD in the last 7 days and 15% had experienced severe MSPD. In a multivariate model, four variables were found to be significantly associated with MSPD, namely being aged $\geqslant$ 40 years (adjusted odds ratio = 1.73), overall job satisfaction (negatively associated) (AOR = 0.37), medium (vs. large) company size (AOR = 1.80) and workgroup safety climate score (negatively associated) (AOR = 0.58).
CONCLUSIONS: The results confirm a link between non-physical factors and work-related musculoskeletal disorders, suggesting that these factors should received increased attention as part of overall health and safety strategies. Organizations should give greater consideration to both the satisfaction of their employees and organizational factors that set the tone for safety climate.

Keywords: Occupational, safety climate, injury, predictor, workplace, psychosocial, job satisfaction

1. Introduction

Musculoskeletal disorders represent a considerable proportion of occupational injuries in many countries and have been recognized by the United Nations and the World Health Organization as a major cost burden for the individual, industry and the community [1]. While estimates for the global burden of general musculoskeletal disorders have been published [2] there are no similar estimates for work-related musculoskeletal disorders. In the absence of accurate global data, national statistics must be relied upon to estimate the extent of the problem. In the USA, the most recent Annual Survey of Occupational Injuries and Illnesses,

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conducted by the Bureau of Labor Statistics, found that over the preceding decade musculoskeletal disorders have consistently accounted for over one-third of all work-related injuries and illnesses involving days away from work [3]. The economic cost is high. In Australia it is estimated that the total cost of work-related injury and illness to the Australian economy, in 2005–2006, was $57.5 billion [4]. Musculoskeletal disorders are a significant proportion of this cost; in 2003, they accounted for approximately 43% of injury and disease-related workers' compensation claims in Australia [5]. In the state of South Australia, musculoskeletal disorders are the most common form of occupational disease, accounting for more than 50% of workers compensation claims [6].

In addition to the economic burden, there can be a significant impact on the lives of those affected, in the most severe cases resulting in permanent disability and an inability to return to work.

The risk of musculoskeletal disorders has been attributed to a wide range of factors; both individual characteristics and occupational factors have been implicated [7]. Based on both experimental and epidemiological investigations, a number of physical occupational exposures are widely accepted as increasing the risk of musculoskeletal disorders. These factors include repetitive tasks, awkward postures, or movements, and application of high force [8]. There is also a growing body of evidence relating to the link between non-physical factors (organizational and psychosocial) and musculoskeletal disorders. Job satisfaction is a psychosocial factor whose link with musculoskeletal disorders has been explored extensively, although the findings have been less consistent than those relating to physical risk factors. Low job satisfaction appears to be associated particularly with back pain, in terms of both prevalence and the severity [9–13], although Vandergrift et al. [14] found that the association only existed for those with high baseline physical exposures.

Another non-physical factor that has been linked with musculoskeletal disorders is safety climate, a component of organizational climate. A recent study found that safety climate was negatively correlated with musculoskeletal disorders, i.e. those with low scores were more likely to be affected [15]. Safer work behavior was suggested as a likely mediator for this relationship, supported by the finding that safety climate was the strongest predictor of safe behavior. In another study, the importance of safety climate was recognized by managers who were interviewed about enablers and barriers to making changes to improve safety [16]. The most commonly cited facilitators were supportive management and effective communication, which are components of safety climate. Despite the broad range of risk factors that have been identified, most studies have focused only on specific occupations or categories of risk factors, meaning that there is limited understanding of the relative contributions of individual and organisational, physical and psychosocial factors. This cross-sectional survey of workers in medium-to-large workplaces in South Australia assesses a broad range of factors within various workplaces and industries, and aims to shed some light on the relative significance of a range of associated factors. A greater awareness of the range of factors, both worker and organizational, which contribute to musculoskeletal disorders is likely to assist not only those with a responsbility for day-to-day occupatonal health management but also in the treatment and rehablitation of work-related injury.

2. Methodology/participants

2.1. Sample and procedure

Purposive sampling was used to ensure that participants were from a range of industries at risk of musculoskeletal disorders. Organizations were included in the study if they had more than 20 employees, were located in the South Australian capital city of Adelaide's metropolitan area and contained a work group of at least 15 employees who undertook substantially similar manual tasks. Organizations that met these criteria were identified through various means, including company directories and employment vacancy listings. In addition, specific industries and organizations were targeted on the based on their high-risk status with regard to musculoskeletal injury (e.g. manufacturing and healthcare). Invitations to participate were sent to the appropriate managers (e.g. safety managers), in most cases by email. In a small number of cases, invitations were sent by facsimile or post in accordance with the organization's preference.

Each participating organization was asked to recruit 15 to 20 of its own employees (on a voluntary basis) who met the following inclusion criteria: employment on an ongoing basis, membership of the same identifiable workgroup, and having English language skills sufficient to complete the questionnaire. A total of 404 workers from 23 companies were recruited. In some cases, multiple work sites within an organization were included, resulting in a total of 29 participat-

ing work groups. Among the sample of companies and workgroups recruited a wide range of occupations and tasks was represented, including those associated with a high risk for musculoskeletal disorders.

Questionnaires were administered individually, face-to-face and in a private room to ensure confidentiality. Participants were assured that access to information from the interviews was restricted to members of the study team (i.e. not accessible by employers).

The survey assessed demographic characteristics and background information (e.g. company size, role of respondent/nature), health and safety climate, musculoskeletal discomfort experienced in the previous 7 days and job satisfaction.

Before commencement, each participant received a study information sheet that stipulated that they were free to withdraw at any time and that confidentiality would be maintained in relation to the information that they provided. A complaints form was provided and participants were asked to sign a consent form. Ethical approval for this study was provided by the University of Adelaide.

2.2. Measurement

The survey instrument was a questionnaire including sections on demographic characteristics and working conditions, health and safety climate, musculoskeletal pain and discomfort and job satisfaction.

Safety climate was measured using an adapted version of a Safety Climate Assessment questionnaire originally developed by Cox and Cheyne [17]. Whysall et al. [18] modified the original version to increase its applicability to the issue of musculoskeletal disorders in the workplace. The original questionnaire has been extensively tested and was selected due to its reliability and sensitivity to detect differences between occupational groups. According to the model upon which the questionnaire is based, safety climate comprises 9 dimensions: management commitment, communication, company prioritization of safety, perceived importance of safety rules and procedures, supportive environment, involvement in health and safety, personal priorities and need for safety, personal appreciation of risk and work demands enable safe working. The dimension score is the aggregate of two questionnaire items, rated on a 5-point Likert scale. For inferential statistics, the overall safety climate score was calculated for each work group, using the average score across all of the dimensions for each of the workers within the group. Work group scores ranged from 3.3 to 4.1, with a median value of 3.7. Each work group score was categorized as high (median value or higher) or low (lower than median value). Musculoskeletal pain and discomfort was measured using a tool that incorporates a body map and a scale assessing both the location and the severity of musculoskeletal pain [19,20]. The questionnaire asks participants to rate the pain/discomfort severity for 10 different body areas on a scale of 1 to 7 (ranging from minimal to extreme) over the previous 7 days. This choice of this time period served two purposes. Firstly to allow for the inclusion of workers who had been employed for 1 year or less in their current role (approximately 10% of workers in our study) and secondly, to avoid introducing recall bias associated with longer time periods among long-standing workers [21]. Ratings within the range of 5 to 7 were categorized as severe. The body map and scale is provided in Supplementary Figure 1.

Job satisfaction was measured using a scale developed by Warr et al. [22]. This instrument has been used widely and evidence has shown that it has good internal reliability. For each of the 16 items on the scale, participants rate their level of satisfaction on a scale of 1 to 7 (ranging from extremely dissatisfied to extremely satisfied).

2.3. Statistical analysis

The questionnaire data were entered into Microsoft Excel® for descriptive statistical analysis. Descriptive statistics were used to report the distribution of individual and work-related characteristics and workers' responses regarding pain and discomfort, safety climate and job satisfaction. To quantify the associations between variables, the Statistical Package for the Social Sciences (SPSS) Version 17® was used. The correlates of five outcome variables were assessed individually: "any MSPD", severe MSPD and MSPD in the neck, shoulders or lower back.

Firstly, bivariate logistic regression analyses were conducted to investigate correlates of MSPD. The analysis included independent variables relating to individual and work-related characteristics, job satisfaction and safety climate. In the next stage a multivariate model predicting each outcome was constructed. Independent variables that correlated with the outcome variable with a p value of < 0.25 were included in the model. In the final model, statistical significance was defined as a two-tailed p-value of 0.05 or less. Spearman's rho test was used to assess correlations between work group safety climate dimension scores and MSPD.

Table 1
Industry type and workgroup characteristics – Australian and New Zealand Standard Industrial Classification (ANZSIC)

Industry	Type of work (work group)
Health care and social assistance	Social assistance services
Health care and social assistance	Sorting and distribution
Health care and social assistance	Nursing
Health care and social assistance	Patient services
Health care and social assistance	Patient services
Health care and social assistance	Patient services
Manufacturing	Manufacture of metal products
Manufacturing	Manufacture of machinery and equipment
Manufacturing	Storage and distribution
Manufacturing	Packing
Manufacturing	Manufacture of metal products
Manufacturing	Manufacture of glass and glass products
Manufacturing	Manufacture of glass and glass products
Manufacturing	Manufacture of glass and glass products
Manufacturing	Printing
Manufacturing	Manufacture of metal products
Manufacturing	Manufacture of food products
Mining	Storage and distribution
Mining	Administration
Professional, scientific and technical services	Profession, scientific and technical services
Professional, scientific and technical services	Profession, scientific and technical services
Professional, scientific and technical services	Professional, scientific and technical services
Public administration and safety	Outdoor maintenance
Public administration and safety	Library
Public administration and safety	Outdoor maintenance
Retail trade	Retail service
Retail trade	Retail service
Services	Repair and maintenance
Services	Laundry

3. Results

3.1. Industry participation

Of 198 eligible organizations invited to participate, 23 (12%) were purposively recruited into the study. The sample comprised 61% service and 39% manufacturing and mining organizations (Table 1). In terms of size, according to Australian Bureau of Statistics definitions [23], the majority of organizations (78%) were large (200 or more employees) and the remainder (22%) were of medium-size (20–199 employees).

3.2. Worker characteristics and questionnaire responses

Table 2 presents descriptive statistics for demographic and work-related characteristics and responses to job satisfaction and MSPD questionnaires. The median age of participants was 38 years. The median hours worked per week was 38 and individual workloads were categorized by an ergonomist, according to the criteria outlined in the Dictionary of Occupation Titles [24], as sedentary to light (46%) and medium to heavy (54%). The majority of participants (87%) indicated that, overall, they were satisfied with their jobs. Forty percent reported that they had experienced musculoskeletal pain and discomfort (MSPD) in the last 7 days and 15% had experienced severe MSPD. Workers were asked to identify the body area(s) in which they had experienced pain. The shoulder was the most common location of pain (experienced by 47% of those who reported pain), followed by the lower back (39%) and neck (32%). For the safety climate checklist, taking into account the mix of negatively and positively worded items, the item that received the most positive responses was *"I am strongly encouraged to report unsafe conditions"* (49% strongly agreed and 43% agreed) and the most negative responses were given for the construct *"In my workplace the chances of developing a work-related health problem are quite high"* (16% strongly agreed and 33% agreed). Responses to all questionnaire items are summarized in Supplementary Item 2.

3.3. Factors associated with MSPD: bivariate

To identify potential predictors of MSPD, bivariate analyses were conducted. To explore the possibil-

Fig. 1. Workplace safety climate dimension scores (ave.) according to musculoskeletal pain and discomfort (MSPD).

Table 2
Workers: characteristics and questionnaire responses

Personal and job characteristics								
Gender	Male		Female					
	N	%	N	%				
	197	49	206	51				
Age group (years)	< 30		30–39		40–49		> 49	
	N	%	N	%	N	%	N	%
	119	30	95	24	91	23	97	24
Language*	ESB		NESB					
	N	%	N	%				
	348	89	44	11				
Working hours/week	< 35		35–44		> 44			
	N	%	N	%	N	%		
	84	22	260	68	37	10		
Workload	Sedentary/ light		Medium/ heavy					
	N	%	N	%				
	184	46	220	54				
Questionnaire responses								
Job satisfaction	Dissatisfied		Not sure		Satisfied			
	N	%	N	%	N	%		
	17	4	34	8	352	87		
MSPD (in last 7 days)	Any		Severe					
	N	%	N	%				
	161	40	62	15				
By body location:**			N	%				
	Neck		52	32				
	Shoulder		76	47				
	Upper arm		5	3				
	Elbow		18	11				
	Forearm		6	4				
	Wrist		30	19				
	Hand		15	9				
	Upper back		22	14				
	Lower back		63	39				
	Legs and feet		47	29				

*ESB = English-speaking background; NESB = non-English-speaking background. **Proportion of 'any' pain.

ity that the cause of pain varies according to the body area affected, factors associated with the areas of highest prevalence (neck, shoulder and lower back) were assessed separately. From Table 3 it can be seen that age group (⩾ 40 years), overall job satisfaction, work group safety climate and company size were all significantly associated with MSPD. Job satisfaction was also associated with other specific categories: severe MPSD and experiencing MSPD in the shoulder and lower back. Safety climate was associated with experiencing MSPD in the neck or shoulder. Industry type was associated only with shoulder pain and exposure to any vibration (whole body or upper limb) was associated only with lower back pain.

3.4. Factors associated with MSPD: multivariate model

The next step was to develop a model to describe the relative contributions of factors associated with MSPD. *Adjusted* odds ratios were determined after including all of the independent variables found to be significant in the bivariate analyses (Table 3). For inclusion in the multivariate model, statistical significance was defined as two-tailed p-value of less than 0.25.

In the multivariate model (Table 4), the independent variables most consistently associated with the different categories of MSPD were safety climate, age group and job satisfaction. Safety climate was associated with all of the MSPD outcomes with the exception of the lower back. Age group was associated with 'any' MSPD, 'severe' MSPD and neck pain, but not with shoulder or lower back pain. Job satisfaction was significantly associated with all categories of MSPD except neck and shoulder pain. Company size (medium vs. large) was associated only with MSPD (any) and being female and working long hours were associated only with severe MSPD.

Table 3
Factors associated with musculoskeletal pain and discomfort (MSPD) – bivariate analysis

	Any MSPD		Severe MSPD		MSPD by body location					
					Neck		Shoulder		Lower back	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Personal and job characteristics										
Age group (⩾ 40 years)	1.53*	1.02 – 2.29*	2.48*	1.41 – 4.39*	1.75	0.96 – 3.17	1.52	0.92 – 2.52	1.41	0.82 – 2.42
Gender (being female)	1.17	0.78 – 1.74	1.51	0.87 – 2.61	1.36	0.75 – 2.44	1.23	0.74 – 2.03	1.06	0.62 – 1.82
Non-English speaking background	1.10	0.34 – 3.54	1.46	0.67 – 3.22	0.86	0.32 – 2.31	1.54	0.74 – 3.21	0.36	0.11 – 1.20
Working 40 or more hours per week	1.01	0.63 – 1.60	1.51	0.83 – 2.73	1.20	0.63 – 2.30	1.27	0.73 – 2.23	0.76	0.39 – 1.48
Medium to heavy workload^	0.95	0.63 – 1.41	1.29	0.74 – 2.23	0.97	0.54 – 1.74	0.86	0.52 – 1.41	1.33	0.77 – 2.30
Exposed to vibration	1.40	0.91 – 2.15	0.98	0.55 – 1.77	1.01	0.54 – 1.90	0.89	0.52 – 1.54	1.86*	1.07 – 3.23*
Organizational characteristics										
Overall satisfaction with job	0.38*	0.21 – 0.69*	0.47*	0.24 – 0.95*	0.56	0.26 – 1.19	0.45*	0.23 – 0.86*	0.43*	0.22 – 0.85*
Industry type (services vs. manufacturing)	1.04	0.69 – 1.56	0.77	0.45 – 1.33	0.74	0.41 – 1.34	0.56*	0.34 – 0.93*	1.28	0.73 – 2.25
Company size (medium vs. large)	1.64*	1.05 – 2.56*	0.87	0.43 – 1.76	0.98	0.47 – 2.04	1.36	0.75 – 2.47	0.85	0.42 – 1.72
Safety climate of work group (high vs. low)	0.64*	0.43 – 0.95*	0.62	0.36 – 1.08	0.48*	0.26 – 0.88*	0.44*	0.26 – 0.75*	1.03	0.60 – 1.76

*Significant, $p < 0.05$. ^Compared with sedentary to light workload.

Table 4
Factors associated with musculoskeletal pain and discomfort (MSPD) – multivariate analysis

	Any MSPD		Severe MSPD		By body location					
					Neck		Shoulder		Lower back	
	Adjusted OR	95% CI –	Adjusted OR	95% CI –	Adjusted OR	95% CI –	Adjusted OR	95% CI –	Adjusted OR	95% CI –
Personal and job characteristics										
Age group (⩾ 40 years)	1.73*	1.14 – 2.64*	3.06*	1.65 – 5.67*	1.96*	1.07 – 3.60*	1.61	0.95 – 2.72	1.46	0.84 – 2.54
Gender (being female)			2.12*	1.11 – 4.05*						
Non-English speaking background									0.38	0.11 – 1.29
Working 40 or more hours per week			2.27*	1.16 – 4.46*						
Exposed to vibration	1.27	0.81 – 1.98							1.76	1.00 – 3.11
Organizational characteristics										
Overall satisfaction with job	0.37*	0.20 – 0.70*	0.44*	0.21 – 0.94*	0.63	0.28 – 1.38	0.51	0.26 – 1.00	0.44*	0.22 – 0.90*
Industry type (services vs. manufacturing)							0.64	0.38 – 1.08		
Company size (medium vs. large)	1.80*	1.07 – 3.04*								
Safety climate of work group (high vs. low)	0.58*	0.38 – 0.90*	0.51*	0.27 – 0.94*	0.44*	0.23 – 0.82*	0.48*	0.28 – 0.82*		

*Significant, $p < 0.05$. ^Compared with sedentary to light workload.

3.5. Safety climate and MSPD

Since safety climate emerged as an important factor, the relationship was explored further by assessing each of the 9 dimensions individually (Table 5). The analysis revealed that personal appreciation of risk, management commitment and company prioritization of safety were the dimensions most strongly correlated with MSPD. This was consistent across all categories of MSPD with the exception of lower back pain. Interestingly, none of the safety climate dimensions were significantly correlated with lower back pain.

4. Discussion and conclusion

Work-related MSPD is multifactorial in origin. Associations with a broad range of factors have been

Table 5
Spearman's rho correlation between workplace safety climate dimensions and musculoskeletal pain and discomfort (MSPD)

			MSPD by body location		
	Any MSPD	Severe MSPD	Neck	Shoulder	Lower back
Dimension					
Management commitment	−0.19**	−0.14**	−0.19*	−0.25**	−0.10
Communication	−0.07	−0.05	−0.07	−0.06	0.03
Company prioritization of safety	−0.19**	−0.13**	−0.16**	−0.22**	−0.06
Perceived importance of safety rules and procedures	0.02	0.05	0.10	0.10	0.01
Supportive environment	−0.13**	−0.08	−0.12*	−0.13**	−0.07
Involvement in health and safety	−0.05	0.00	0.01	−0.07	0.06
Personal priorities and need for safety	0.02	0.04	−0.03	0.01	0.07
Personal appreciation of risk	−0.19**	−0.19**	−0.13**	−0.27**	−0.08
Work demands enable safe working	−0.11*	−0.08	−0.05	−0.21**	−0.01

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

previously reported [25], but there does not appear to be a consensus regarding which combination of factors is most predictive of MSPD. Based on analysis of the factors that we surveyed, four variables were found to be significantly associated with MSPD, namely being aged ⩾ 40 years (AOR = 1.73), overall job satisfaction (negatively associated) (AOR = 0.37), medium (vs. large) company size (AOR = 1.80) and work group safety climate score (negatively associated) (AOR = 0.58). Age group, safety climate and job satisfaction emerged as the independent variables most consistently associated with the different categories of MSPD. The relationship is not surprising and is probably a result of both genetic factors [26, 27] and a longer period of exposure to occupational risk factors. However, previous findings relating to the link between age and MSPD are mixed. Studies by Hildebrandt [28] and Naidoo et al. [29] support our findings, while other studies found no difference between age groups regarding the likelihood of reporting MSPD [30–35] These differences may be due to several factors including the use of varying self-report questionnaires and cultural difference in the populations under study, which ranged from highly educated professional groups [30] to unskilled rural workers [29].

Highlighting the importance of organizational factors, safety climate was the factor most strongly associated with all MSPD categories. This is in accordance with the finding from a recent study that low safety climate scores among nursing staff were strongly correlated with MSPD, possibly mediated by safer work behaviors among those who perceive the work environment to be safe [15]. It was found that safety climate was in fact the strongest predictor of safe behavior, highlighting the importance of organizational commitment to improving safety culture. This is consistent with the strong correlation between MSPD and personal appreciation of risk, management commitment and company prioritization of safety in our study.

There is a growing awareness of the importance of psychosocial factors as a contributor to musculoskeletal disorders [25]. We decided to explore one particular aspect which is likely to be influenced by both organizational and individual factors – job satisfaction. In our sample, those who indicated that they were dissatisfied or unsure about their level of satisfaction with their jobs were almost three times as likely to report MSPD as those who were satisfied. However, the directionality of this association is unclear; while there is an increasing body of evidence suggesting that job satisfaction plays an important role in the development of musculoskeletal disorders, it also seems plausible that experiencing MSPD could lead to a decline in job satisfaction.

In terms of physical risk factors, the results suggest that the number of hours worked is more predictive of MSPD than the nature of the work. Longer periods of exposure could increase the risk of musculoskeletal disorders due to either acute injury from a single event or a cumulative effect [36]. Surprisingly, having a heavy workload was not significantly associated with any category of MSPD, although those who worked 40 or more hours per week were more than twice as likely as those who worked fewer hours to have experienced severe MSPD (AOR = 2.27). In accordance with previous findings linking exposure to vibration and MSPD, particularly back pain [14,37]) we found that those exposed to vibration were almost twice as likely to experience MSPD in the lower back (AOR = 1.76), although this was just short of statistical significance.

Although our selection was purposive, including high-risk job/industry characteristics, surprisingly, the prevalence of musculoskeletal disorders in our study (40%) was lower than the rates reported in similar studies, which range from 49% to 76% [18,38,39].This

may reflect actual differences between populations sampled, but it is also possible that the method of administration had an influence. Ours was the only study that administered questionnaires face-to-face. This method was selected due to a number of advantages, including the ability to clarify ambiguous, complex or sensitive questions, to allow for the participants to be more spontaneous, and to obtain a higher item response rate [39]. It is possible that the self-administration method of other studies resulted in over-reporting. In our face-to-face interviews, some reported instances of MSPD were excluded following clarification by the interviewer (e.g. if not experienced in the previous 7 days), but this type of clarification is not possible with self-administration. It is also suggested that false reporting may be more likely due to the more anonymous nature of self-administration, e.g. workers who are disgruntled with management may be more inclined to provide negative responses. Another possibility is that the face-to-face method employed in our study resulted in under-reporting. Although participants were assured that responses were to remain confidential, it is possible that due to the face-to-face method and on-site location, concerns about confidentiality remained. Fears about job security may have led to reluctance to report MSPD. In accordance with other recent findings, the areas of the body most frequently affected by MSPD were the shoulder, lower back and neck [18,38,39].

Strengths of the study are the large sample size (400 workers, from 23 organizations, interviewed face-to-face) the broad range of industries represented (including manufacturing, repair and maintenance, scientific and technical services, retail, administration, healthcare and personal services) and the scope of the questionnaires. The assessment tools used have been extensively tested and previously validated [18]. However, it is important to acknowledge that the outcome variable (MSPD) is based on a subjective measure, being self-reported. There is no reason to suspect that reported presence or absence of pain would be unreliable, but the reliability of the numerical severity scale is uncertain. There is likely to be variability between respondents because the scale does not include descriptive anchors. A study comparing pain assessment methods concluded that numerical rating scales are accurate in terms of whether pain has reduced or increased but less accurate in estimating intensity, i.e. the percentage of increase or decrease [40]. It is also important to acknowledge that, although cross-sectional studies can be suggestive of risk factors, the ability to establish causality is limited by the lack of information on the temporal relationship between exposure and outcome.

Building on recent evidence, our survey confirms a link between non-physical factors and work-related musculoskeletal disorders, suggesting that these factors should receive increased attention as part of overall health and safety strategies. Organizations should give greater consideration to both the satisfaction of their employees and organizational factors that set the tone for safety climate. In terms of future research, longitudinal or prospective studies should be undertaken to further elucidate the role of these factors.

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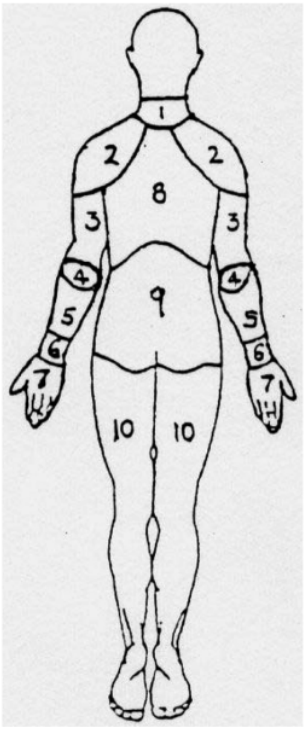
Supplementary material

Item 1

PAIN/DISCOMFORT RATING

1. Have you felt any discomfort in the last 7 days? Y/N
2. If yes, please mark a cross on the diagram below where you have felt discomfort in the last 7 days.



3. For each part you have marked circle a number on the scales below to show *how much* discomfort you have felt:

If you have not experienced any pain or discomfort, leave this section blank.

	Minimal discomfort						Extreme discomfort
1) Neck	1	2	3	4	5	6	7
2) Shoulders	1	2	3	4	5	6	7
3) Upper arms	1	2	3	4	5	6	7
4) Elbows	1	2	3	4	5	6	7
5) Forearms	1	2	3	4	5	6	7
6) Wrist	1	2	3	4	5	6	7
7) Hand	1	2	3	4	5	6	7
8) Upper back	1	2	3	4	5	6	7
9) Lower back	1	2	3	4	5	6	7
10) Lower limbs	1	2	3	4	5	6	7

Item 2

Safety climate checklist responses

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Management commitment					
Management acts decisively when a health and safety concern has been raised	31%	51%	13%	5%	0%
In my workplace management acts quickly to correct health and safety problems	30%	49%	13%	7%	1%
Communication					
Health and safety information is always brought to my attention by my line manager/supervisor	32%	51%	13%	4%	0%
There is good communication here about health and safety issues which affect me	31%	50%	14%	6%	1%
Company prioritization of safety					
Management here considers health and safety to be equally as important as production	34%	39%	18%	7%	2%
I believe health and safety issues are assigned a high priority	37%	42%	13%	7%	1%
Perceived importance of safety rules and procedures					
Some health and safety rules and procedures don't need to be followed to get the job done safely	2%	16%	18%	39%	25%
Some health and safety rules are not really practical	5%	29%	17%	33%	16%
Supportive environment					
I am strongly encouraged to report unsafe conditions	50%	43%	6%	2%	1%
I can influence health and safety performance here	25%	53%	17%	5%	0%
Involvement in health and safety					
I am involved in informing management of important health and safety issues	24%	51%	17%	7%	1%
I am involved in the ongoing review of health and safety	14%	38%	30%,	17%	1%
Personal priorities and need for safety					
Health and safety is the number one priority in my mind when completing a job	27%	40%	19%	12%	2%
It is important to me that there is a continuing emphasis on health and safety	35%	56%	7%	2%	0%
Personal appreciation of risk					
I'm sure it's only a matter of time before I develop a work-related health problem	13%	29%	27%	24%	7%
In my workplace the chances of developing a work-related health problem are quite high	16%	32%	25%	24%	3%
Work demands enable safe working					
Production targets rarely conflict with health and safety measures	7%	34%	32%	21%	6%
I am always given enough time to get the job done safely	14%	41%	21%	19%	5%

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