Impact of occupational stress and other psychosocial factors on musculoskeletal pain among Chinese offshore oil installation workers

W Q Chen, I T-S Yu, T W Wong

Aims: To explore the relation between psychosocial factors and musculoskeletal pain in Chinese offshore oil installation workers.

Methods: Half of all offshore workers (being a representative sample) in a Chinese oil company were invited to complete a self-administered questionnaire providing information on sociodemographic characteristics, occupational stressors, type A behaviour, social support, coping style, health related behaviour, past injuries, and musculoskeletal pain. Factor analysis was used to identify the sources of occupational stress and the domains of type A behaviour and coping style. Logistic regression analyses were used to study the relations between psychosocial factors and musculoskeletal pain in each body region.

Results: The prevalence of musculoskeletal pain over the previous 12 months varied between 7.5% for elbow pain and 32% for low back pain; 56% workers had at least one complaint. Significant associations were found between various psychosocial factors and musculoskeletal pain in different body regions after adjusting for potential confounding factors. Occupational stressors, in particular stress from safety, physical environment, and ergonomics, were important predictors of musculoskeletal pain, as was coping by eating behaviour.

Conclusions: These observations supported the widely accepted biopsychosocial model of musculoskeletal disorders and suggested that in future studies of work related musculoskeletal disorders, psychosocial factors must be given due consideration.

Musculoskeletal pain, in particular low back pain, is one of the most common occupational health problems and accounts for a large number of workers’ compensation days and disability in modern industrialised societies. It is believed that occupational musculoskeletal pain is caused by multiple factors, generally categorised into mechanical and psychosocial ones. Various mechanical factors have been found to be associated with pain in different body regions. Heavy physical work, heavy or frequent manual operations, repeated rotation of the trunk, whole body vibration, and prolonged sitting were positively associated with low back pain. Working with hands at or above shoulder level, flexion of the neck, static contractions, monotonous or repetitive work with arms, high working pace, and unsuitable work place were responsible for neck and shoulder pain.

Psychosocial factors at work have also been shown to play important roles in the development of musculoskeletal pain. Important psychosocial factors included work demands and decision latitude, social support, type A behaviour, and psychological distress. After reviewing 59 relevant studies, Bongers and colleagues concluded that monotonous work, high perceived workload, time pressure, low control on the job, lack of social support from colleagues, and stress symptoms were related to musculoskeletal problems. Carayon and colleagues reviewed work organisation, job stress, and work related musculoskeletal disorders, and concluded that work organisation and psychosocial factors at work could contribute to upper extremity disorders. They further indicated that work organisation and ergonomic factors might interact to affect the musculoskeletal system.

Offshore oil production is generally regarded as a stressful occupation. Apart from receiving stressors that are common to most workplaces, they are also exposed to stressors that are specific to the offshore setting. The physical stressors include noise, vibration, poor lighting and ventilation, confined living and working space, adverse offshore weather conditions, long working hours, and shift work, etc. Psychosocial stressors cover job characteristics (work load, variety, clarity, control), perceived risk (fire, explosion, blowout, travelling by helicopter or ships, etc), job insecurity, work-family interface, and the lack of certain types and sources of social support.

Norman and colleagues found that musculoskeletal disorders were the second top cause for medical evacuations among offshore oil workers in the North Sea from 1976 to 1984. This implied that musculoskeletal pain would be an important health problem among the offshore oil workers. However, most studies on work related musculoskeletal pain have mainly focused on onshore occupational groups, and very little is known about the situation in offshore oil workers. We conducted a comprehensive study on occupational stress and its influence on health of Chinese offshore oil installation workers. We intend to describe the prevalence of musculoskeletal pain and explore the impact of occupational stress and other work related psychosocial factors.

SUBJECTS AND METHODS
The company and study subjects
The study subjects were offshore workers from an offshore oil company in South China, which employed about 1100 offshore oil workers working on five installations. The offshore workers were divided into two groups which took
Main messages

- Musculoskeletal complaints were not uncommon among Chinese offshore oil installation workers, given the highly selective nature of the workforce. More than half of them had at least one complaint over a 12 month period. Low back pain was the most common and serious problem.
- Occupational stressors, in particular stress from safety, physical environment, and ergonomics, were important predictors of musculoskeletal pain.
- Maladaptive eating behaviour was the most important coping strategy and was significantly associated with musculoskeletal pain in six of the nine body parts.
- For social support, the only positive association was between poor instrumental support from supervisors and pain in the wrists/hands.
- Type A behaviour pattern did not have an independent effect on musculoskeletal pain after adjusting for other covariates.

Data analyses

First, factor analysis with a varimax rotation was used to identify the sources of occupational stress and the domains of TABP and coping style. A factor was included when the eigenvalue was greater than one. Within each factor, the items with the highest factor loading were then identified and loaded onto this factor. A factor loading greater than 0.40 was regarded as important. Then, the relations between musculoskeletal pain in each body region and each item of occupational stress and other psychosocial factors at work were analysed, using multiple forward stepwise logistic regression analysis with adjustment for age, educational level, marital status, duration of offshore employment, job title, and history of injury in the past 12 months. Although we did not have any reason to believe that musculoskeletal pain in different body parts could be affected by different psychosocial variables, as other risk factors (personal characteristics, physical factors, etc) associated with musculoskeletal pain in different body parts could be different, the influence of different psychosocial variables might differ after adjusting for these covariates in the multivariate analyses. All factors thought to affect musculoskeletal pain, other than psychosocial factors, were entered together in the first step. The psychosocial factors were selected on the basis of a forward stepwise procedure during a second step. The criterion for inclusion was a p value of <0.05 while the criterion for exclusion was a p value of ≥0.10. In the logistic regressions, for each body region, the subjects with musculoskeletal pain in that body region during the past 12 months were compared with those free from musculoskeletal pain in all the nine body regions.

Policy implications

- Despite the high level of automation in the production processes, musculoskeletal pain is not uncommon among Chinese offshore workers. Occupational health service providers should be well aware of its presence.
- The associations between psychosocial factors and musculoskeletal pain suggested that psychosocial factors must be given due considerations when studying or managing musculoskeletal complaints.
- As the causal relation between psychosocial factors and musculoskeletal pain could not be confirmed in this cross-sectional study, prospective cohort studies would be needed to confirm or refute the causal links.
RESULTS
The basic characteristics of the workers were reported in detail in an earlier report.22 All workers were males and had a mean age of 32.43 (SD 8.65) and a mean platform working experience of 8.24 years (SD 7.39). Over 77% had received at least high school education; 68.4% were married.

Sources of stress
From factor analyses, nine sources of occupational stress were identified and have been reported previously.23 These were “physical environment of workplace”, “safety”, “interface between job and family/social life”, “career and achievement”, “organisational structure”, “living environment”, “ergonomics”, “management problem and relationship with others at work” and “managerial role” in descending order of importance. They explained 62.5% of the total variance.

Type A behaviour pattern (TABP)
Factor analysis of the 14 characteristics of TABP yielded two domains that explained 36.27% of the total variance. One domain reflected the traits of impatience and hard driving, while the other involved speed and ambition.

Coping style
From factor analysis of 20 items of coping style, five domains with eigenvalue over 1 were identified, which explained 51.03% of the total variance. According to the context of the items loading on each factor, they were defined as: “eating behaviour”, “external/social behaviour”, “escaping/abreaction behaviour”, “positive attitude/denying behaviour” and “internal behaviour”.

Musculoskeletal pain and its association with occupational stress, TABP, social support, coping style, and health related behaviours
Table 1 presents the prevalence of musculoskeletal pain by body regions in the past 12 months and the past week, as well as their impact on the workers’ daily life activities. Low back pain was the most common and serious musculoskeletal health problem for this group of workers, and elbow pain was the least important. A total of 316 respondents (56.3%) complained of one or more symptoms; 124 (22.1%) had one symptom, 77 (13.7%) had two, 31 (5.5%) had three, 31 (5.5%) had four, and 50 (9.4%) had five or more symptoms.

Table 2 shows the results of the multivariate logistic regression analyses with adjustments for age, educational level, marital status, duration of working offshore, job title, and the history of work related injury in the past year. Pain in the neck, shoulders, upper back, knees, and ankles/feet was increased by several perceived sources of occupational stress and eating coping style. In addition, upper back pain was also increased by the escaping/abreaction coping style. On the other hand, pain in the knees and ankles/feet was decreased by managerial role. Low back pain was only affected by occupational stressors. Elbow pain was related to stress from the physical environment and the coping styles of “eating” and “escaping/abreaction”. Pain in the wrists/hands was increased by stress from the living environment on platforms and ergonomics, as well as the external/social coping behaviour. Pain in the wrists/hands was increased by ergonomics stress and the internal coping style. Important psychosocial risk factors that affected more than half of the body regions included stress from safety, physical environment, and ergonomics, as well as coping by eating behaviour. In addition to the psychosocial factors, neck pain was also significantly positively associated with the following job types: drilling workers, electricians, mechanics, material and power workers, with odds ratios (OR) ranging between 2.45 and 3.70. Elbow pain was significantly increased in electricians (OR 4.02) and power workers (OR 8.03), whereas low back pain was significantly less among managers (OR 0.34). A history of injury in the past 12 months was significantly associated with an increased risk of pain in the spine, including the neck, and upper and lower back regions (OR 1.82–2.13).

DISCUSSION
This was the first comprehensive study on the influence of occupational stress and other psychosocial factors at work on musculoskeletal pain among Chinese offshore oil workers. The results showed that musculoskeletal pain, in particular low back pain, was not uncommon among this group of active workers. Occupational stressors, in particular stress from safety, physical environment, and ergonomics, were important predictors of musculoskeletal pain, as was coping by eating behaviour. Social support and the type A behavioural pattern appeared to be less important.

The prevalence of musculoskeletal pain in this study was in general lower than that reported among workers in other heavy industries, for example, steel workers,24 construction workers,25 and workers in an automobile assembly plant,26 although low back pain was the most common disorder as in the other groups of workers. The lower prevalence might be associated with a high level of automation on oil platforms, as well as the possible healthy worker effect arising from the self-selection of these offshore workers.21

Associations between occupational stress and musculoskeletal pain
Many previous studies on work stress and musculoskeletal disorders focused on work demands, the job decision latitude model, symptoms of stress, dissatisfaction with job, and monotonous work.1 11–13 16 17 A few studies revealed that other

<table>
<thead>
<tr>
<th>Body region</th>
<th>In the past 12 months</th>
<th>Impacting activity</th>
<th>During the past 7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>140</td>
<td>25.0</td>
<td>37</td>
</tr>
<tr>
<td>Shoulders</td>
<td>112</td>
<td>20.0</td>
<td>31</td>
</tr>
<tr>
<td>Elbows</td>
<td>42</td>
<td>7.5</td>
<td>16</td>
</tr>
<tr>
<td>Wrists/hands</td>
<td>76</td>
<td>13.5</td>
<td>20</td>
</tr>
<tr>
<td>Upper back</td>
<td>77</td>
<td>13.7</td>
<td>20</td>
</tr>
<tr>
<td>Low back</td>
<td>180</td>
<td>32.4</td>
<td>56</td>
</tr>
<tr>
<td>Hips/thighs</td>
<td>47</td>
<td>8.4</td>
<td>20</td>
</tr>
<tr>
<td>Knees</td>
<td>113</td>
<td>20.1</td>
<td>32</td>
</tr>
<tr>
<td>Ankles/feet</td>
<td>57</td>
<td>10.2</td>
<td>22</td>
</tr>
</tbody>
</table>
Table 2  Significant odds ratios (95% CI) of psychosocial risk factors for musculoskeletal pain in different body regions in the past 12 months†

<table>
<thead>
<tr>
<th>Psychosocial factors</th>
<th>Body region</th>
<th>Neck</th>
<th>Shoulders</th>
<th>Elbows</th>
<th>Wrists/hands</th>
<th>Upper back</th>
<th>Low back</th>
<th>Hips/thighs</th>
<th>Knees</th>
<th>Ankles/feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support</td>
<td>Lack of instrumental support from supervisors</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Occupational stressors</td>
<td>Interface between job and family/social life</td>
<td>1.34* (1.05–1.70)</td>
<td>1.35* (1.02–1.71)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>1.53** (1.26–1.93)</td>
<td>1.54*** (1.20–1.99)</td>
<td>–</td>
<td>–</td>
<td>1.46** (1.18–1.82)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Physical environment of workplace</td>
<td>1.45** (1.14–1.79)</td>
<td>1.32** (1.03–1.68)</td>
<td>1.54** (1.05–2.25)</td>
<td>1.60** (1.18–2.16)</td>
<td>1.68** (1.21–2.16)</td>
<td>1.28* (1.02–1.58)</td>
<td>–</td>
<td>–</td>
<td>1.69** (1.22–2.35)</td>
</tr>
<tr>
<td></td>
<td>Living in environment</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Managerial role</td>
<td>1.30* (1.03–1.61)</td>
<td>–</td>
<td>–</td>
<td>1.63** (1.12–2.08)</td>
<td>1.33* (1.01–1.74)</td>
<td>–</td>
<td>1.74** (1.23–2.46)</td>
<td>1.31* (1.02–1.69)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Ergonomics</td>
<td>1.40* (1.08–1.81)</td>
<td>1.53** (1.16–2.02)</td>
<td>1.78** (1.15–2.74)</td>
<td>1.65** (1.05–2.02)</td>
<td>1.31* (1.09–2.09)</td>
<td>–</td>
<td>1.36* (1.02–1.80)</td>
<td>1.57** (1.13–2.19)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Coping styles</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Eating behaviour</td>
<td>1.60** (1.20–2.15)</td>
<td>–</td>
<td>–</td>
<td>1.60** (1.20–2.15)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>External/social</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Escaping/abreaction</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Health related behaviours</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Current drinker v non drinker</td>
<td>3.32** (1.34–8.26)</td>
<td>3.92** (2.02–7.62)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

†Multiple forward stepwise logistic regression analysis with adjustment for age, educational level, marital status, duration of offshore employment, job title, and history of injury in the past 12 months. The adjustment factors were entered in step 1 and the psychosocial factors were selected into the model using the forward stepwise approach in step 2.

*p<0.05, **p<0.01, ***p<0.001.

Associations between other psychosocial factors and musculoskeletal pain.

Musculoskeletal pain is often considered as a multifactorial condition, with both physical and psychosocial factors playing a significant role. In our study, we found significant associations between psychosocial factors and musculoskeletal pain in various body regions. For instance, poor social support was associated with increased odds of musculoskeletal pain in the neck and shoulders. This finding is consistent with previous research indicating that social support can act as a buffer against stress, thereby reducing the likelihood of developing musculoskeletal pain.

However, the associations were not uniform across all body regions. For example, occupational stressors were strongly linked to musculoskeletal pain in the knees and ankles/feet, but not in other regions. This suggests that the nature of the work environment and the specific tasks performed can significantly influence the development of musculoskeletal pain.

Overall, our findings highlight the importance of considering psychosocial factors in the management and prevention of musculoskeletal pain, especially in high-risk populations such as offshore workers. Further research is needed to explore the mechanisms behind these associations and to develop effective strategies for intervention.
work in more favourable working environments and hence less exposed to physical hazards.

Coping style, in particular eating behaviour, was important in predicting musculoskeletal pain. Current drinking was significantly related to pain in the elbow, wrists/hands, and hips/thighs. Unlike the findings in the previous studies, we did not find an association between smoking and musculoskeletal pain in this study. This might be due to the multiple collinearity between smoking and drinking and the “eating behaviour” coping style, as the latter was a complex variable composed of four items: eating, drinking alcohol, drinking tea/coffee, and smoking. Other coping styles, “escaping/abreaction”, “external/social”, and “internal” were also found to have an impact on pain in different body regions.

Limitations and strengths of the study

The cross-sectional nature of the study did not allow a clear causal relation between psychosocial factors and musculoskeletal pain to be established. Underreporting of health problems by the workers was possible for fear of redep

REFERENCES


