**Original**

# Relationship between Social-psychological Factors and Work-related Musculoskeletal Disorders: A Questionnaire Survey of Japanese Radiological Technologists

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## Abstract

Objective: The purpose of this study was to conduct a self-reported questionnaire survey on work-related musculoskeletal disorders (WMSDs) among Japanese radiological technologists (RTs) and to report the relationship between related WMSDs and social-psychological factors.

Methods: Information of RTs in Okayama Prefecture, Japan, were surveyed from February to April 2021 through mail and websites. Data on individual characteristics, social-psychological factors in the workplace, and the presence of WMSDs were collected. Social-psychological factors were assessed using the Work Organization Assessment Questionnaire (WOAQ). Multivariate logistic regression analysis was used to assess the relationship between WMSDs and the WOAQ total score. The same analysis was performed for the five WOAQ sub-items.

Results: Among the 123 participants, 67 (54.5%) had WMSDs, and approximately 60% had lower back pain. Multivariate logistic regression analysis revealed that WMSDs were significantly associated with the WOAQ total score, with an odds ratio of 0.96 (95% CI=0.93–0.99; p=0.017). In the sub-item analysis, the "quality of relationship with management" and the "quality of the physical environment" revealed a significant relationship with WMSDs.

Conclusions: We conducted a questionnaire survey on WMSDs in Japanese RTs. WMSDs were observed in more than half of the RTs, and most of them had lower back pains. It was suggested that WMSDs of RTs were positively influenced by social-psychological factors, which is also observed in other medical professions.

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**—Key words—**

work-related musculoskeletal disorders, radiological technologists, work organization assessment questionnaire

## Introduction

Work-related musculoskeletal disorders (WMSDs) are symptoms caused or aggravated by occupational risk factors, such as feeling of discomfort, damage or persistent body pains in muscles, joints, tendons, ligaments, nerves, bones, and the circulatory system[1)–4)]. WMSDs are the most prevalent occupational diseases in modern societies and working populations. These have been reported not only in the industry but also in the medical field, especially among medical professionals such as nurses, occupational and physical therapists[5)–9)]. Daily work activities, such as lifting and transferring of patients, tiring positions, and awkward postures can cause WMSDs[5)–9)], which are mostly characterized by lower back pain and cervicobrachial syndrome. It has also been reported that these WMSDs symptoms are greatly affected by social-psychological factors in addition to physical factors[7)10)–12)].

Radiological technologists (RTs) have heavy physical burdens encountered in work, such as radiation exposure, equipment operation, wearing of lead aprons, and patient handling (transfer to the imaging table, patient positioning, etc.). The associated psychological burden is also expected to be heavy due to the urgency of

the work, demand for accurate evaluation, overwork due to shifting work schedules, and human interactions within the workplace. Considering all these, WMSDs of RTs are expected to be influenced by both physical and social-psychological factors, as experienced by other medical professionals. However, there are only few reports on the topic. It seems that the WMSDs of RTs have more social-psychological factors than physical ones. This is due to less direct patient-handling tasks at work compared to other healthcare professionals. Instead, RTs are expected to work under stress, such as providing accurate images during an emergency and interacting with multiple professions. Therefore, it is important to also consider and emphasize the social-psychosocial factors associated with WMSDs.

In previous studies on the relationship between WMSDs and social-psychological factors among medical professionals, there are many reports using questionnaires on individual psychological factors related to pain, fear, and depressive symptoms, and others[13)–15)]. However, due to the nature of the medical profession, it seems more appropriate to consider social-psychological factors, including human relationships in the workplace and the work environment. The Work Organization Assessment Questionnaire (WOAQ) was reported in 2006 by Griffiths et al. and is a good predictor of well-being, subjective health, and job satisfaction[16)]. The WOAQ was initially developed to help organizations in the manufacturing sector identify the factors related to the design and management of work, and to measure their impact on employee health and well-being[16)]. Although the WOAQ was originally developed for the manufacturing industry, it has already been validated and applied to a range of sectors, occupations, and workplace environments. For example, it has been utilized successfully in the medical (i.e., nurses)[17)18)], public sector[19)], and financial sectors. There are also few reports on WMSDs for RTs.

Based on the nature of the work of RTs, it is important to examine related social-psychological factors using the WOAQ. Therefore, the purpose of this study was to conduct a questionnaire survey and examine the relationship between WMSDs and social-psychological factors in Japanese RTs.

## Methods

### ＜Participants＞

The 735 participants were all members of the Okayama Prefectural Radiological Technologists Association in Japan.

### ＜Survey method＞

This cross-sectional study used questionnaires and was conducted from February to April 2021. After obtaining approval from the board of directors of the Okayama Prefecture Radiological Technologists Association, the questionnaire and the QR code of the Google form were sent to the RT participants by mail. The purpose of this study was explained by writing on paper or online, and it was clearly stated that the respondents agreed to participate in the study by answering the questionnaire. Most of the participants completed the online questionnaire. However, those who had difficulty answering online wrote the answers on paper and returned the questionnaire by mail.

### ＜Questionnaire＞

The survey items included individual characteristics (age, sex, height, weight, BMI, years of experience, etc.), presence or absence of WMSDs in the past year (most painful region), and WOAQ. The WOAQ was measured as a general 28-item summative factor, with a five-factor structure. The five-factor structure includes: "quality of relationships with management," "reward and recognition," "workload issues," "quality of relationships with colleagues," and "quality of the physical environment"[16)]. The participants were asked to rate how problematic or good each item was for them on a 5-point Likert scale (from "Very much more" or "Enough" [5] to "Very bad" or "Not at all" [1]). The score was calculated using the total score of each item (score range: 28–140 points). The structure of each factor was calculated in the same manner. Since the item "Workload issues" is a reverse item, the score was converted and calculated for statistical analysis. The lower the WOAQ score, the greater the influence of social-psychological factors.

### ＜Statistical Analysis＞

Multivariate logistic regression analysis was performed to examine the social-psychological factors associ-

**Table 1** Participant characteristics

| | | WMSDs | Non-WMSDs |
|---|---|---|---|
| Number | | 67 | 56 |
| Age (Years) | ＜39 | 19 | 25 |
| | 40–59 | 38 | 26 |
| | 60＜ | 10 | 5 |
| Sex | Male | 43 | 45 |
| | Female | 24 | 11 |
| BMI | ＜18.5 | 2 | 4 |
| | 18.5–25.0 | 48 | 46 |
| | 25.0＜ | 17 | 6 |
| Work hours/day | ＜4 | 17 | 15 |
| | 4–8 | 38 | 35 |
| | 8–9 | 12 | 6 |

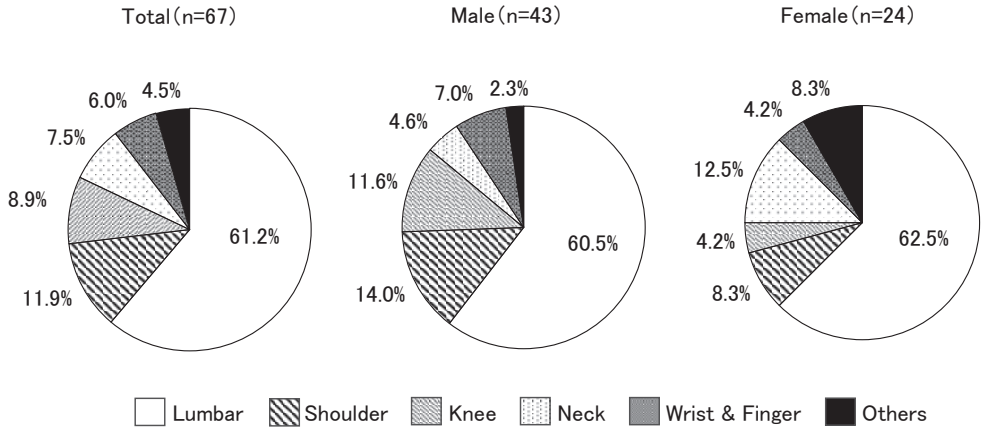


**Fig. 1** Body parts breakdown of WMSDs

ated with WMSDs, with the presence of WMSDs as the dependent variable and WOAQ total score as the explanatory variable. Next, the analysis was performed using the total score for each subordinate item as the explanatory variable. The model was adjusted for age, sex, BMI, and working hours. STATA Ver. 16 (Stata Statistical Software: Release 16; StataCorp LLC, TX, USA) was used for statistical analysis, and all significance levels were set at p＜5%.

**＜Ethics＞**

This study was approved by the Ethics Review Committee of the Okayama Healthcare Professional University (No. 0023).

## Results

A total of 735 RTs were asked to participate in the study and 123 RTs responded (88 males and 35 females; response rate of 16.7%). The characteristics of the respondents are presented in Table 1. Sixty-seven RTs (54.5%) had WMSDs, including 41 (61.2%) in the lumbar region, 8 (11.9%) in the shoulder, 6 (8.9%) in the knee, 5 (7.5%) in the neck, 4 (6.0%) in the wrist and fingers, and 3 (4.5%) in other locations (Fig. 1).

Multivariate logistic regression analysis revealed that the WOAQ total score was significantly associated with WMSDs. The odds ratio was 0.96 (95% CI=0.93–0.99; p=0.017) (Table 2). In the sub-analysis, the “quality of relationships with the management” and the “quality of the physical environment” were measured as significant factors related to WMSDs. The odds ratio were 0.54 (95% CI=0.33–0.89; p=0.016) and 0.41 (95% CI=0.21–0.83; p=0.013), respectively (Table 2).

## Discussions

According to the results of our questionnaire, 54.5% of the RTs who responded had WMSDs, with back

**Table 2** Association between WOAQ and WMSDs (Logistic regression analysis*)

| Variable | | Odds Ratio | 95% Confidence interval Lower | Upper | p-value |
|---|---|---|---|---|---|
| WOAQ Total score | | 0.96 | 0.93 | 0.99 | 0.017 |
| Sub-item | Quality of relationships with the management | 0.54 | 0.33 | 0.89 | 0.016 |
| | Reward and recognition | 0.57 | 0.30 | 1.09 | 0.090 |
| | Workload issues | 0.80 | 0.48 | 1.33 | 0.393 |
| | Quality of relationships with colleagues | 0.79 | 0.52 | 1.21 | 0.289 |
| | Quality of physical environment | 0.41 | 0.21 | 0.83 | 0.013 |

*Model was adjusted for Age (<39, 40–59, 60<), Sex, BMI (<18.5, 18.5–25.0, 25.0<), and Working hours (<4, 4–8, 8–9).

pain as the most frequent complaint. The prevalence of WSMDs among RTs was not as high compared to the studies conducted for other medical professions[7)10)11)]. The low prevalence rate in RTs may be due to the difference in physical load encountered during work. RTs may not perform as many patient-handling tasks compared to other healthcare professionals, as reported in previous studies.

The logistic regression analysis results suggested that the WOAQ total score had a positive effect on WMSDs, which was consistent with the report by Yoshimoto et al[14)]. However, previous studies have not included relationships with line managers and supervisors, along with other factors related to the workplace environment. Therefore, it is important that we examined social-psychological factors using the WOAQ, which showed a significant relationship with WMSDs. It is expected that the WMSDs of RTs are also greatly affected by physical factors. However, only the social-psychological factors were included in this study because the sample size was too small to comprehensively examine both factors.

Previous studies using the WOAQ for prosthetists/orthotists had reported that WMSDs were significantly associated with psychosocial factors, physical factors, sex, and weekly working hours (odds ratio of 3.6)[12)]. The odds ratio in our study was not as high as compared to these reports, which may be because of the difference in work content and the quality of the workplace. Moreover, the results of the "quality of the physical environment" in the sub-analysis is noteworthy. This item mainly asked about workplace safety, work environment, equipment, and risks, which included radiation exposure. This suggests that it is necessary to enhance occupational safety measures, including radiation exposure prevention. Meanwhile, the results of "quality of relationships with the management" in the sub-analysis appeared to be similar with the other medical professionals.

The "Workload Issues" item was expected to influence WMSDs, but it was not a significant factor. This may be due to variations in the hospital functions, working departments, and family structures of the RTs. Owing to the small sample size, this result could not be analyzed in detail.

The strength of this study is that we conducted a survey of the workplace situation of RTs and focused on the relationship between WMSDs and socio-psychological factors using the WOAQ. The results highlight that it is important to consider social-psychological factors in the occupational health and safety management of RTs. However, this study had some limitations. First, the response rate of the questionnaire was low, and the number of participants was small, thus the influence of selection bias of the subjects cannot be ruled out in the present study. Therefore, it is necessary to increase the number of participating RTs for future surveys. Second, the results of this study were based on a single analysis of only social-psychological factors only. It has been reported that musculoskeletal disorders are affected by various factors, including social-psychological and physical factors[10)12)20)]. Further analysis from various perspectives should be conducted in future studies. Intervention strategies that reduce various stressors in the workplace may help to reduce the risk of WMSDs in RTs. It is necessary for physical therapists to help in the improvement of the occupational health management of RTs.

## Conclusion

We administered a questionnaire survey on WMSDs to Japanese RTs. WMSDs were found in 54.5% of the RTs who responded, and approximately 60% had lower back pains. We also analyzed the relationship between

WMSDs and social-psychological factors using the WOAQ. The results suggested that the total WOAQ score is positively associated with WMSDs. The results of this study imply that WMSDs of RTs are influenced by social-psychological factors, as seen as other medical profession.

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**Appendix** Contents of the questionnaire of WOAQ (Modified from report by Griffiths A, et al[16])

| Factor structure | Question text | category | | | | |
|---|---|---|---|---|---|---|
| | | Very bad | Well bad | Neither | Fairly good | Very much more |
| Quality of relationships with management (9–45) | Communication with line manager / supervisor | 1 | 2 | 3 | 4 | 5 |
| | Support from line manager / supervisor | 1 | 2 | 3 | 4 | 5 |
| | Clear reporting line(s) | 1 | 2 | 3 | 4 | 5 |
| | Senior management attitudes | 1 | 2 | 3 | 4 | 5 |
| | Appreciation of efforts from line manager / supervisor | 1 | 2 | 3 | 4 | 5 |
| | Clear roles and responsibilities | 1 | 2 | 3 | 4 | 5 |
| | Clear company objectives, values, procedures | 1 | 2 | 3 | 4 | 5 |
| | Status / recognition in the company | 1 | 2 | 3 | 4 | 5 |
| | Feedback on your performance | 1 | 2 | 3 | 4 | 5 |
| | | Not at all | Not so much | Neither | Fairly | Enough |
| Reward and recognition (7–35) | Opportunities to use your skills | 1 | 2 | 3 | 4 | 5 |
| | Opportunities for learning new skills | 1 | 2 | 3 | 4 | 5 |
| | Opportunities for promotion | 1 | 2 | 3 | 4 | 5 |
| | Variety of different tasks | 1 | 2 | 3 | 4 | 5 |
| | Sufficient training for your current job | 1 | 2 | 3 | 4 | 5 |
| | Flexibility of working hours | 1 | 2 | 3 | 4 | 5 |
| | Consultation about changes in your job | 1 | 2 | 3 | 4 | 5 |
| | | Not at all | Not so much | Neither | Fairly | Enough |
| Workload issues (4–20)* | Impact of work on family / social life | 5 | 4 | 3 | 2 | 1 |
| | Pace of work | 5 | 4 | 3 | 2 | 1 |
| | How you would rate your workload | 5 | 4 | 3 | 2 | 1 |
| | Impact of family / social life on work | 5 | 4 | 3 | 2 | 1 |
| | | Very bad | Well bad | Neither | Fairly good | Very much more |
| Quality of relationships with colleagues (2–10) | How well you get on with your co-workers (socially) | 1 | 2 | 3 | 4 | 5 |
| | How well you work with your co-workers (as a team) | 1 | 2 | 3 | 4 | 5 |
| | | Very bad | Well bad | Neither | Fairly good | Very much more |
| Quality of physical environment (6–30) | Safety at work | 1 | 2 | 3 | 4 | 5 |
| | Exposure to physical danger | 1 | 2 | 3 | 4 | 5 |
| | Facilities for taking breaks (rest room, lunch break areas, etc) | 1 | 2 | 3 | 4 | 5 |
| | Work surroundings (noise, vibration, light, temperature, etc) | 1 | 2 | 3 | 4 | 5 |
| | Work station/space / work space (or multisite location) | 1 | 2 | 3 | 4 | 5 |
| | The equipment / IT that you use | 1 | 2 | 3 | 4 | 5 |

( ): score range *: The "Workload issues" question is a reversal item

# 作業関連性筋骨格系障害と社会心理的要因の関連について
## ―診療放射線技師に対する調査―

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―キーワード―
作業関連性筋骨格系障害，診療放射線技師，社会心理的要因

目的：この研究の目的は，日本の診療放射線技師を対象に，作業関連性筋骨格系障害（WMSDs）に対する自己申告アンケート調査を実施し，WMSDs と社会心理的要因の関連を報告することである．

方法：公益社団法人岡山県診療放射線技師会の理事会承認のもとに，県内の全会員 735 名に対して郵送方式あるいはインターネット方式（Google Form）による無記名式調査を実施した．調査期間は 2021 年 2～4 月で，調査項目は，個人属性（年齢，性別，身長，体重，BMI，経験年数など），過去 1 年間の WMSDs の有無（最も疼痛が強い部位），社会心理的要因とした．社会心理的要因には Work Organization Assessment Questionnaire（WOAQ）を使用した．WMSDs の有無を従属変数，WOAQ の総得点を説明変数として多変量ロジスティック回帰分析を行った．また WOAQ の 5 つの下位項目（「管理者との関係の質」，「報酬と認知」，「作業負荷」，「同僚との関係の質」，「環境の質」）についても同様に解析を行った．

結果：有効回答者 123 人のうち，67 人（54.5％）が WMSDs を有しており，その約 60％ が腰痛であった．多変量ロジスティック回帰分析の結果，WOAQ の総得点は，WMSDs に有意な関連を示し，オッズ比は 0.96（95％ CI=0.93～0.99；p=0.017）であった．また下位項目の解析では，「管理者との関係の質」「環境の質」が，WMSDs と有意な関連を示した．

結論：診療放射線技師の約半数は WMSDs を有しており，社会心理的要因が診療放射線技師の WMSDs に影響していることが示唆された．

［COI 開示］本論文に関して開示すべき COI 状態はない

（日職災医誌，70：124―130，2022）