Habitual Smoking and Musculoskeletal Symptoms in Japanese Blue-Collar Workers

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Abstract: Habitual Smoking and Musculoskeletal Symptoms in Japanese Blue-Collar Workers: Masaiwa INOUE, et al. Department of Hygiene, Yamaguchi University School of Medicine—

Whether smoking is associated with musculoskeletal disorders is still debatable. To determine the prevalence of musculoskeletal disorders among smoking and non-smoking employees doing strenuous physical work, we conducted a survey by means of a questionnaire that was distributed as a part of the annual health examination in a pulp and paper mill. The questions included smoking habit and musculoskeletal symptoms in the neck, arms, shoulders, back and low back. The analysis was performed on 905 male employees working in the manufacturing plant. For most age groups and regions, the percentage of smokers was greater among subjects with symptoms than among subjects without symptoms. Particularly among subjects in their 20s and 50s, there were significant differences in the percentage of smokers with symptoms and the percentage of smokers without symptoms ($P < 0.01$ for both age groups). Although the percentage of ex-smokers was greater among subjects without symptoms than among subjects with symptoms, the difference was not significant except among subjects in their 50s ($P = 0.023$). The percentages of ex-smokers in their 50s were greatest among subjects without symptoms for all 5 musculoskeletal regions. When the percentages of current smokers were analyzed according to the number of regions in which musculoskeletal symptoms were present, the number of regions tended to increase with the percentage of smokers but not significantly. Our study supports an association between habitual smoking and musculoskeletal symptoms with a proposal for an educational campaign aimed at helping individuals quit smoking.

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Key words: Musculoskeletal symptoms, Smoking, Blue-collar workers

Smoking is now generally accepted in Japan to have a negative influence on health, and an effort is being made to eliminate smoking from the workplace to prevent both direct and passive exposure to cigarette smoke among workers. In 1996, the Ministry of Labor of Japan devised countermeasures to deal with the problem of smoking in the workplace¹). Interestingly, some fairly recent epidemiologic studies have shown an association between smoking and musculoskeletal disorders including low back pain. Musculoskeletal disorders are, of course, an important occupational issue, and in 1994 the Ministry of Labor printed guidelines for the prevention of low back pain in the workplace²). It was reported by the Japanese Ministry of Labor in 2000 that low back pain is the primary cause of occupational sick leave for 4 d or more³), so that these two very important workplace problems may interact.

It has been shown in a longitudinal study conducted among metal workers in Finland that smoking was a predictive factor for the occurrence of musculoskeletal symptoms⁴), cessation of smoking was also associated with a high rate of musculoskeletal symptoms. It has been reported in a survey of Japanese construction workers that heavy smoking was related to low back pain⁵), and in a study covering 13 different occupations in the Netherlands it has been shown that pain in the extremities is related to smoking more than to pain in the neck or back⁶). A definite link between smoking and low back pain has been shown in a cross-sectional survey of 29,424 twins though no causality was present⁷). It has been reported in a review study that smoking was considered a minor risk factor, but not a cause, of low back pain⁸).

Musculoskeletal disorders are associated particularly with heavy physical labor and mental stress, so that it is still debatable whether smoking is associated with musculoskeletal disorders^{4, 6, 9–12}). Because this question remains and because there are few studies in Japan

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examining the association between habitual smoking and musculoskeletal disorders among workers, we conducted a survey to determine the prevalence of such disorders among smoking and non-smoking employees doing strenuous physical work in a pulp and paper mill. We investigated musculoskeletal disorders in the neck, arms, shoulders, back and low back among employees in different age groups.

Subjects and Methods

The investigation was conducted in a pulp and paper mill in the western part of Japan, where more than 1,100 workers were engaged in papermaking and related occupations. All study subjects and the president of the factory provided informed consent. Data regarding smoking habit and musculoskeletal symptoms were gathered by means of a questionnaire that was distributed as a part of the 1999 annual health examination, in which 1,115 employees (1,004 men, 111 women) took part. The subjects provided written answers to the questionnaire, and an interview was conducted by an occupational physician who was affiliated with the mill with each respondent at the time of the health examination to confirm the responses provided on the questionnaire. The part of the questionnaire that dealt directly with smoking habit comprised three questions: (1) Have you ever smoked regularly during your lifetime? (2) Do you smoke regularly at present? (3) How many cigarettes a day on average do you smoke? One question was used to address musculoskeletal symptoms: Have you felt pain or stiffness in the neck, arms, shoulders, back, or low back within the past year? Other questions as to physical workload, past history of consultation with orthopedist, and stress condition were also asked during the same health examination with another questionnaire. In the questionnaire about physical workload, workers were asked whether they had heavy physical strain, frequent lifting, long standing, and unnatural postural stress in their routine work. Stress condition was obtained pointing on a scale of 0 to 10 (a higher number indicated a higher level of stress), and we defined workers with up to 5 points as workers with less stress and more than 5 points as workers with much stress. To prevent any influence of the type of work or sex of the respondents, the analysis considered only 905 male employees working in the manufacturing plant. White-collar males, males under orthopedic treatment (e.g., for lumbar hernia), and females were excluded.

We analyzed the survey results in the following manner. Subjects currently smoking were divided into groups according to age: 20–29 yr, 30–39 yr, 40–49 yr, and 50–60 yr. Subjects in these groups were then divided according to the presence and absence of musculoskeletal pain, and the percentages of smokers experiencing and not experiencing pain in each of the 5 musculoskeletal

regions were tallied. Next, like the smokers, ex-smokers were divided into groups according to age and then according to the presence or absence of musculoskeletal pain. The percentages of ex-smokers experiencing and not experiencing pain in each of the 5 musculoskeletal regions were tallied. Third, the number of regions (1, 2, 3, 4 or 5) in which pain was experienced was determined for each subject, and the total numbers of patients experiencing pain in 1, 2, 3, 4 or all 5 regions were calculated. The percentages of current smokers that made up each of these totals were calculated. Fourth, the average number of cigarettes smoked per day was categorized as 9 or less, 10–19, 20–29 and 30 or more, and these numbers were compared between smokers who experienced musculoskeletal pain and smokers who did not. This was done on a per region basis. Fifth, the association between musculoskeletal symptom and confounding factors such as physical workload, age, past history of consultation with orthopedist and stress condition was examined.

The Mantel-Haenszel procedure was used to determine the statistical significance of differences found for any of the comparisons among smokers and among ex-smokers. The Mann-Whitney's U test was used to analyze differences among smokers in the number of regions in which musculoskeletal symptoms were present as a function of the number of cigarettes smoked. Logistic regression analyses were performed to investigate the association between musculoskeletal symptoms and related factors. A P value of <0.05 was considered statistically significant.

Results

The age breakdown of subjects was as follows: 16.8% (n=152) were in their 20s, 10.6% (n=96) in their 30s, 29.8% (n=270) in their 40s, and 42.8% (n=387) in their 50s or above. Five hundred and sixty-two employees (62.1%) had symptoms in at least 1 of the 5 musculoskeletal regions. The percentage for the neck was 21.5% (n=195), for arms was 16.9% (n=153), for shoulders was 34.6% (n=313), back was 13.4% (n=121), and low back was 39.9% (n=361). The percentage of current smokers in the total study group was 57.3% (n=519); 62.5% (n=95) were in their 20s, 55.2% (n=53) were in their 30s, 60.0% (n=162) were in their 40s, and 54.0% (n=209) were in their 50s. The percentages of current smokers making up the groups of subjects with and without symptoms are shown per age and per musculoskeletal region in Table 1. For most age groups and regions, the percentage of smokers was greater among subjects with symptoms than among subjects without symptoms. Particularly among subjects in their 20s and 50s, there were significant differences in the percentage of smokers with symptoms and the percentage of smokers without symptoms ($P<0.01$ for both age groups). Table

Table 1. Percentage of smokers among male workers (by age group) with and without musculoskeletal pain*

	20's (P<0.01)		30's		40's		50's (P<0.01)	
	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)
neck	75.7 (28)	58.3 (67)	50.0 (14)	57.4 (39)	62.3 (38)	59.3 (124)	63.8 (44)	51.9 (165)
arm	66.7 (12)	61.9 (83)	66.7 (8)	53.6 (45)	63.8 (30)	59.2 (132)	63.2 (48)	51.8 (161)
shoulder	68.6 (35)	59.4 (60)	55.0 (22)	55.4 (31)	63.3 (62)	58.1 (100)	58.9 (73)	51.7 (136)
back	71.4 (15)	61.1 (80)	47.8 (11)	57.5 (42)	59.5 (22)	60.1 (140)	67.5 (27)	52.4 (182)
low back	74.1 (40)	56.1 (55)	56.1 (23)	54.5 (30)	65.8 (79)	55.3 (83)	57.5 (84)	51.9 (125)

*Musculoskeletal pain is shown by region.

Table 2. Percentage of non-smokers among male workers (by age group) with and without musculoskeletal pain*

	20's		30's		40's		50's	
	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)
neck	24.3 (9)	41.7 (48)	50.0 (14)	42.6 (29)	37.7 (23)	40.7 (85)	36.2 (25)	48.1 (153)
arm	33.3 (6)	38.1 (51)	33.3 (4)	46.4 (39)	36.2 (17)	40.8 (91)	36.8 (28)	48.2 (150)
shoulder	31.4 (16)	40.6 (41)	45.0 (18)	44.6 (25)	36.7 (36)	41.9 (72)	41.1 (51)	48.3 (127)
back	28.6 (6)	38.9 (51)	52.2 (12)	42.5 (31)	40.5 (15)	39.9 (93)	32.5 (13)	47.6 (165)
low back	25.9 (14)	43.9 (43)	43.9 (18)	45.5 (25)	34.2 (41)	44.7 (67)	42.5 (62)	48.1 (116)

* Musculoskeletal pain is shown by region.

Table 3. Percentage of ex-smokers among male workers (by age group) with and without musculoskeletal pain*

	20's		30's		40's		50's (P<0.05)	
	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)	with % (n)	without % (n)
neck	6.7 (2)	10.7 (8)	17.6 (3)	20.4 (10)	22.4 (11)	28.3 (49)	30.2 (19)	34.3 (86)
arm	14.3 (2)	8.8 (8)	0 (0)	22.4 (13)	23.1 (9)	27.9 (51)	26.2 (17)	35.3 (88)
shoulder	5.4 (2)	11.8 (8)	18.5 (5)	20.5 (8)	24.4 (20)	28.6 (40)	31.1 (33)	34.6 (72)
back	6.3 (1)	10.1 (9)	0 (0)	23.6 (13)	29.0 (9)	26.7 (51)	15.6 (5)	35.5 (100)
low back	7.0 (3)	11.3 (7)	17.9 (5)	21.1 (8)	24.8 (26)	29.1 (34)	31.1 (38)	34.9 (67)

* Musculoskeletal pain is shown by region.

2 shows the percentage of non-smokers among male workers with and without musculoskeletal pain. Breakdowns of the ex-smokers are shown in Table 3. Although the percentage of ex-smokers was greater among subjects without symptoms than among subjects with symptoms, the difference was not significant except among subjects in their 50s ($P=0.023$). The percentages of ex-smokers in their 50s were greatest among subjects without symptoms for all 5 musculoskeletal regions. When the percentages of current smokers were analyzed according to the number of regions in which musculoskeletal symptoms were present, the number of regions tended to increase with the percentage of smokers but not significantly (Table 4). Smokers categorized by the number of cigarettes smoked per day were as follows: 2.3% ($n=12$) smoked 9 or less, 24.1% ($n=125$) smoked

Table 4. Percentage of smokers per number of regions in which musculoskeletal pain occurred

	%	(n)
1 region	58.9	(152)
2 regions	59.4	(76)
3 regions	66.0	(68)
4 regions	61.1	(22)
5 regions	67.6	(25)

10–19, 53.4% ($n=277$) smoked 20–29, and 20.2% ($n=105$) smoked 30 or more. When musculoskeletal pain was analyzed according to the number of cigarettes smoked per day, there were no statistical differences

Table 5. Musculoskeletal pain* in relation to number of cigarettes smoked per day

		≤9/d % (n)	10–19/d % (n)	20–29/d % (n)	30≤/d % (n)
neck	with	3.2 (4)	25.0 (31)	49.2 (61)	22.6 (28)
	without	2.0 (8)	23.8 (94)	54.7 (216)	19.5 (77)
arm	with	4.1 (4)	23.5 (23)	54.1 (53)	18.4 (18)
	without	1.9 (8)	24.2 (102)	53.2 (224)	20.7 (87)
shoulder	with	3.7 (7)	21.4 (41)	54.2 (104)	20.8 (40)
	without	1.5 (5)	25.7 (84)	52.9 (173)	19.9 (65)
back	with	5.3 (4)	21.3 (16)	48.0 (36)	25.3 (19)
	without	1.8 (8)	24.5 (109)	54.3 (241)	19.4 (86)
low back	with	3.1 (7)	23.9 (54)	50.0 (113)	23.0 (52)
	without	1.7 (5)	24.2 (71)	56.0 (164)	18.1 (53)

* Musculoskeletal pain is shown by region.

Table 6. Association of the relating factors with musculoskeletal symptoms

Variable	Odds Ratio (95% Confidence Interval)
smoking	1.49 (1.13–1.97)
workload	1.73 (1.28–2.36)
age	1.02 (1.00–1.03)
past history	2.31 (1.33–4.25)
stress	1.56 (1.17–2.09)

(Table 5). Analysis of the confounding factors showed a significant association of the adjusted odds ratio for smoking (1.49, 95% confidence interval 1.13 to 1.97) with musculoskeletal symptoms (Table 6).

Discussion

In this study, we surveyed male pulp and paper mill workers and tried to elucidate an association between habitual smoking and musculoskeletal symptoms. It may be difficult to pinpoint the precise relation between the two in the working population, but if smoking is a risk factor for musculoskeletal disorders, occupational health professionals need to introduce health education along with programs that deal with workplace health and safety issues specific to musculoskeletal disorders. Such programs would be considered a motivational tool aimed at helping industrial workers with and without apparent musculoskeletal disorders to quit smoking. Furthermore, it is likely very important for employers in Japan to recognize the benefits of health education aimed at motivating employees to stop smoking since smoking is thought to decrease productivity.

Musculoskeletal disorders were present in 62.1% of the male pulp and paper industry workers that we surveyed. It has been shown in a previous study in Japan

that the average prevalence was 28.4% for hand-arm pain, 28.7% for shoulder pain, and 53.2% for low back pain among construction workers and that there was a difference in the incidence depending on the workers' actual duties⁵. When our results were compared with these previously reported results, employees in the present study had a higher prevalence of musculoskeletal disorders. We suggest two reasons for this. One is that data pertaining to musculoskeletal symptoms in our study were gathered from self-reports and not from clinical examinations. Perhaps if musculoskeletal disorders tallied in our study were only those documented under clinical examination, the percentage of employees with such disorders in our study would not have been so high. The second explanation is that workers in the pulp and paper industry typically engage in intense physical activity (e.g., working with their hands above shoulder level, heavy lifting, standing for long periods) and the work is fast-paced. For example, every day they must carry paper machine parts weighted 20 kg and there is a need to work in a twisted position in a narrow space when they engage in routine checking and watching tasks related paper machines or deal with machine malfunctions. It is therefore important to prevent musculoskeletal disorders especially among workers in the pulp and paper industry.

In the present study, the percentage of smokers was greater among employees with musculoskeletal symptoms than among employees without symptoms, so that there could be a link between smoking and musculoskeletal disorders. It has been shown in a 10-yr prospective study of workers in the metal industry that that smoking was a predictor for the occurrence of musculoskeletal symptoms⁴. A significant association between smoking and musculoskeletal pain has been reported in a survey of 6,681 persons representing working class households in Norway¹³. We did not find

a close association between smoking and musculoskeletal symptoms; but, as others, found only a possible connection between the two. It has also been reported in a 4-yr prospective study that heavy physical work was a stronger predictor of low back pain in smokers than in non-smokers¹⁴. The high percentage of current smokers among workers with musculoskeletal symptoms in our study might be explained at least in part by the work styles that are particular to the paper industry.

Two age groups stood out in our study. The percentage of current smokers was significantly higher among employees with musculoskeletal symptoms than among employees without symptoms in the 20–29 yr age category and the 50–60 yr age category. For ages 30–49, the percentage of smokers among employees with musculoskeletal symptoms was not high in comparison to the percentage among employees without symptoms. For ages 20–29, i.e. for young workers, the musculoskeletal structure may be directly affected by smoking, so that smoking appears to be a predictor of musculoskeletal disorders in this age group. The demand for heavy work from young workers is usually higher than that from other workers and due to this difference in work quality and quantity among generations, they may feel severe musculoskeletal disorders and the smoking habit due to their dissatisfaction. Then in the 30s and 40s, the effect of smoking on the musculoskeletal structure would be less clear because workers in their 30s and 40s may become susceptible to other risk factors for musculoskeletal disorders, for example as mental stress, socioeconomic pressure, or other stressors associated with middle age. In the 50s, the effect of smoking may emerge clearly again due to the long history of smoking. We consider, on the basis of the present results, that the effects of habitual smoking on musculoskeletal symptoms may differ according to age. Moreover, we support the possibility that there is a relation between smoking and musculoskeletal pain intensity that differs by generation¹⁵. It has been found in a cohort study of students approximately 14 yr of age that smoking increases the risk for low back pain¹⁶. The negative effect of smoking on health including a possible link between smoking and later development of musculoskeletal disorders should be brought to the public's attention, especially that of the young generation.

In our study, the percentages of ex-smokers were higher among employees without musculoskeletal symptoms than among employees with symptoms in most age groups and pertaining to most musculoskeletal regions. Moreover, a significant difference in the percentage of ex-smokers was shown between employees in their 50s with and without symptoms. This may indicate a link between the cessation of smoking and fewer musculoskeletal disorders. If stopping smoking decreases the likelihood of musculoskeletal symptoms, the health

benefits should be emphasized in public educational programs aimed at helping the population stop smoking, but it has been reported in a prospective study that some subjects who stopped smoking during follow-up had musculoskeletal disorders⁴. This result did not match ours, but subjects in our study had stopped smoking of their own accord. There are many psychosocial factors at work when a person quits smoking, any one of which could be associated with musculoskeletal symptoms.

Though the increase in the number of regions subject to symptoms was not statistically significant in our study, the tendency was for the number of regions to increase with an increase in the number of cigarettes per day. This lends weight to the notion that smokers are susceptible to musculoskeletal disorders. Smokers experience a higher degree of musculoskeletal pain than non-smokers¹⁵. Habitual smoking is most likely linked not only to the occurrence of musculoskeletal disorders but also to the degree and number of such disorders. Moreover, in this study, there were no statistical differences in the number of cigarettes smoked per day. These results may indicate that it is important for the prevention of musculoskeletal disorders to stop smoking rather than to only reduce the number of cigarettes smoked per day.

Although the present study focused on habitual smoking and its influence on musculoskeletal disorders, many other risk factors have been reported, such as injury history, body mass index (BMI), physical workload and several psychosocial factors^{4, 6, 9–12}. It has been reported that a BMI over 26 was associated with musculoskeletal symptoms but a BMI of 23–<26 was not⁴. It has been shown that social status was related to musculoskeletal pain in Norway population¹³ and that psychosocial factors were associated with musculoskeletal symptoms in salespeople⁹. In our results of logistic regression analyses, there was a significant association between musculoskeletal symptoms and such factors as smoking, physical workload, age, past history of consultation of an orthopedist, and stress conditions. We believe that to prevent musculoskeletal disorders occupational health professionals need to promote health management strategies for the workplace aimed at both reducing environmental risks and guiding employees not to smoke.

The reason for the connection between habitual smoking and musculoskeletal symptoms is not clear. Some hypotheses have been put forth; one being that nicotine leads to degeneration of the muscles, joints, and discs through reduced blood flow and hypoxia. Another is that the decreased bone density often observed in smokers leads to musculoskeletal symptoms.

Although our results of this cross-sectional study with a questionnaire have some limitations in interpretation of the cause and effect association, it seems probable that the age of workers may be related to musculoskeletal

symptoms as reported in the past^{5, 10, 12}). A longitudinal study will make the point clearer, but it seems that it may be difficult in the future to collect data on the same employees as their job and working environment from the 20s through the 50s may not be the same.

In summary, our study supports an association between habitual smoking and musculoskeletal symptoms. An educational campaign suited to the workplace and aimed at helping individuals quit smoking may be of use in preventing workplace-associated musculoskeletal disorders.

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