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Low Back Pain and Smoking in a Community Sample in Japan

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Abstract: Low Back Pain and Smoking in a Community Sample in Japan: Tetsuya OTANI, *et al.* Department of Public Health, Gunma University School of Medicine—A cross-sectional study with a self-administered questionnaire was conducted in order to examine the association between low back pain and smoking. The subjects analyzed were 6,891 adults aged 40–69 yr, who lived in a downtown district in Isesaki City, Gunma, Japan. There was a positive association between cigarette smoking and low back pain in men. The age-adjusted odds ratios of low back pain were 1.32 (95% confidence interval (CI) 1.10, 1.57) for 1–20 cigarettes smoked per day and 1.40 (95% CI 1.11, 1.76) for 21 or more. The association had similar strength after adjustment for alcohol consumption, physical exercise, body mass index, non-musculoskeletal disease, education, occupation, and whether living with parents, living with a child or children, or living alone. The multivariate odds ratios for low back pain were 1.29 (95% CI 1.03, 1.62) for 1–20 cigarettes smoked per day and 1.36 (95% CI 1.03, 1.80) for 21 or more. In conclusion, smoking was significantly related to low back pain, even if adjusted for other potential risk factors.
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Key words: Low back pain, Smoking, Japan

Low back pain is a common health problem among the general population in industrialized societies. Cross-sectional surveys indicated that the lifetime, 12-months period, and point prevalence of low back pain were 59%, 39%, and 19%, respectively, in British adults[1)] and for 12-months the period prevalence was 21% in Hong Kong adults[2)] and 54% in a Danish study population aged 30–50[3)].

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Low back pain affects the gross national product of nations and the quality of life of those having the symptom. Many people who have low back pain are likely to be out of work, taking medication, and probably increasing demands on both primary and secondary health care[4)].

Evidence has been accumulated on the association between smoking and low back pain. Most cross-sectional studies on non-specific low back pain in a review by Goldberg showed positive associations with current smoking in both the general population and the workplace[5)].

The association of smoking with low back pain has been examined in Japanese workers as a covariant of the relationship between various workloads and low back pain. Miyamoto *et al.*[6)] reported that work conditions were associated with low back pain, though smoking was not an effective variable among truck drivers. Ueno *et al.*[7)] observed that heavy smoking contributed to severer low back pain.

Little is known, however, of the association between smoking and low back pain in the general population in Japan. Studies of the general population will be useful in understanding the tendency as a whole because the general population includes workers from a variety of workplaces. In addition, the general population includes 50% or more of women, including self-employed women.

The purpose of the present study is to investigate the association between smoking and low back pain adjusted for potential confounding variables such as age and occupation in a community sample in Japan.

Methods

The Komo-Ise Study, a community-based prospective study, has been conducted in Komochi Village and Isesaki City from 1993 to examine the relationship between lifestyle, sociodemographic and psychosocial factors and mortality or morbidity[8, 9)].

The subjects of the cohort study were all of the residents

Table 1. Age and gender stratified prevalence of low back pain in a Japanese community sample

	Men			Women		
Age (yr)	Total	No. with low back pain	%	Total	No. with low back pain	%
40–49	989	659	66.6	1,065	686	64.4
50–59	1,105	689	62.4	1,282	773	60.3
60–69	1,157	694	60.0	1,293	837	64.7
All ages	3,251	2,042	62.8	3,640	2,296	63.1

aged 40–69 yr of Komochi Village and a downtown district of Isesaki City, identified in the Basic Resident Registers of each area.

Both areas are located in the center of Gunma Prefecture, Japan. In 1995, the population of Komochi Village was 12,141 and that of Isesaki City 120,236. Primary, secondary, and tertiary industry workers accounted for 16.4%, 36.5%, and 47.1% of employed persons in Komochi, and 3.7%, 44.8%, and 51.5% in Isesaki, respectively.

We used baseline data from Isesaki City in 1993 for the analysis, which could represent a district in urbanized Japan[10].

The self-administered questionnaires were distributed through the municipal health center to 7,755 subjects, aged 40–69 yr, living in the district in October 1993. After a few weeks, completed questionnaires were collected in sealed envelopes by the officers. The response rate was 91.1% (n=7,064).

Any episodes of low back pain were considered, by phrasing the question as follows: "Do you have low back pain?" In the present study, the responses "Often" and "Sometimes" were combined in one category as "Pain", and "Hardly ever or never" assigned to the other category as "No pain".

The numbers of cigarettes smoked per day were analyzed by using the three categories: never smoked; those smoking 1 to 20 cigarettes per day; and 21 or more. Ex-smokers were excluded from the present study.

Alcohol consumption was rated by using the question, "Do you drink a lot of alcoholic beverages?" with the answers being "Often", "Sometimes" or "Hardly ever or never". Heavy drinkers were defined as participants "Often" drinking a lot of alcohol, and light drinkers as "Sometimes".

Participants were sorted into three groups according to the frequency of physical exercise during their leisure time: 1) "Often"; 2) "Sometimes"; and 3) "Hardly ever or never". In the present study, the responses "Often" and "Sometimes" were combined in one category.

Body mass index (weight (kg) / height $(m)^2$) was calculated from the self-reported weight and height and categorized into approximate quartiles.

Self-reported morbidity was classified according to the International Classification of Diseases, 9th revision. In the present study, the presence of non-musculoskeletal disease was used as a measure of comorbidity.

Education was measured as the final school background. The participants were divided into three groups, "Compulsory education", "High-school education", and "Post-secondary education".

The participants were asked what kind of work they did during most of the past year and were classified into five groups according to occupation. The categories were: 1) work in an office, nonmanual work, service work, or studying (later referred to as white-collar); 2) work in a factory, transportation and communications occupations, craftsman or construction work (later: blue-collar); 3) merchants and other self-employed (later: self-employed); 4) farming, forest work, or housewife on a farm (later: farmer); 5) jobless.

Participants were asked whether they were living with their parents, with a child or children, or living alone.

Statistical Analysis

We obtained and analyzed data from 6,891 cases who responded to the question on low back pain.

The gender specific prevalence rate for low back pain was calculated according to the potential risk factors mentioned above. The linear trends in potential risk factors were evaluated by entering indicators for each categorical level of exposure or by using median values for each category, with the Cochrane-Armitage test.

The odds ratios were calculated by using logistic regression models. Variables were categorical except age (as a continuous variable). Men and women were analyzed separately.

Data were processed with SPSS version 10.0J and NAP version 4.0[11].

Results

The gender and age stratified prevalence of low back pain is shown in Table 1. Altogether 62.8% of men and 63.1% of women had low back pain. As age increased,

Table 2-1. Prevalence rates and age-adjusted and multivariate odds ratios (OR) with 95% confidence intervals (95% CI) for low back pain in men

Factor	Category	Total	No. with low back pain	%	Age-adjusted OR*	95% CI	Multivariate OR**	95% CI
Cigarettes (No./day)	Never	844	482	57.1	1.00		1.00	
	1–20	1,238	788	63.7	1.32	(1.10, 1.57)	1.29	(1.03, 1.62)
	21+	527	350	66.4	1.40	(1.11, 1.76)	1.36	(1.03, 1.80)
Alcohol consumption	Never	742	451	60.8	1.00		1.00	
	Light drinker	1,648	1,023	62.1	1.04	(0.87, 1.25)	1.18	(0.92, 1.51)
	Heavy drinker	840	554	66.0	1.22	(0.99, 1.50)	1.30	(0.98, 1.73)
Physical exercise	Hardly ever or never	1,611	1,045	64.9	1.00		1.00	
	Often or sometimes	1,595	969	60.8	0.85	(0.74, 0.98)	0.85	(0.69, 1.03)
Body mass index (kg/m^2)	<21	765	479	62.6	1.00		1.00	
	21–22.99	844	526	62.3	0.97	(0.79, 1.19)	0.95	(0.72, 1.26)
	23–24.99	893	544	60.9	0.92	(0.75, 1.12)	0.78	(0.59, 1.03)
	25+	715	476	66.6	1.15	(0.93, 1.43)	1.09	(0.81, 1.46)
Non-musculoskeletal disease	No	1,938	1,166	60.2	1.00		1.00	
	Yes	1,081	693	64.1	1.28	(1.09, 1.50)	1.36	(1.10, 1.68)
Education	Compulsory	1,065	698	65.5	1.00		1.00	
	High-school	1,275	785	61.6	0.80	(0.67, 0.95)	0.80	(0.62, 1.01)
	Post-secondary	792	483	61.0	0.76	(0.62, 0.92)	0.80	(0.61, 1.06)
Occupation	White-collar	793	466	58.8	1.00		1.00	
	Blue-collar	358	235	65.6	1.32	(1.02, 1.71)	1.27	(0.91, 1.75)
	Self-employed	1,214	798	65.7	1.37	(1.14, 1.65)	1.22	(0.97, 1.54)
	Farmer	25	20	80.0	3.07	(1.14, 8.29)	2.89	(0.80, 10.4)
	Jobless	144	79	54.9	0.96	(0.66, 1.38)	0.83	(0.52, 1.33)
Living with parents	No	2,359	1,453	61.6	1.00		1.00	
	Yes	843	561	66.5	1.15	(0.97, 1.37)	1.34	(1.05, 1.70)
Living with a child or children	No	1,215	717	59.0	1.00		1.00	
	Yes	1,987	1,297	65.3	1.25	(1.08, 1.45)	1.29	(1.04, 1.60)
Living alone	No	3,058	1,937	63.3	1.00		1.00	
	Yes	144	77	53.5	0.64	(0.46, 0.90)	0.78	(0.46, 1.32)

*: Odds ratios were adjusted for age. **: Odds ratios were adjusted for age, cigarettes smoked per day, alcohol consumption, physical exercise, body mass index, non-musculoskeletal disease, education, occupation, and whether or not living with parents, living with a child or children, and living alone.

the prevalence rate of low back pain decreased in men (p for trend = 0.002).

Tables 2-1 and 2-2 show the prevalence of low back pain among men and women, respectively, in relation to cigarettes smoked per day, alcohol consumption, physical exercise, body mass index, non-musculoskeletal disease, education, occupation, and whether living with parents, with a child or children, or living alone. As cigarettes smoked per day increased, the prevalence of low back pain significantly increased both in men and women (p = 0.0003 and 0.041, respectively).

The logistic regression analyses showed that low back pain was associated with potential risk factors (Table 2-1, 2-2). All odds ratios were adjusted for age or all factors that were considered as confounders in this study. There was an association between cigarette smoking and low back pain in men. The odds ratios of low back pain were 1.32 (95% confidence interval (CI) 1.10, 1.57) for 1–20 cigarettes smoked per day and 1.40 (95% CI 1.11, 1.76) for 21 or more. The multivariate odds ratios of low back pain in men were 1.29 (95% CI 1.03, 1.62) for 1–20 cigarettes smoked per day and 1.36 (95% CI 1.03, 1.80) for 21 or more.

With regard to the association of other factors with low back pain, in women there was a positive trend of low back pain with body mass index that was not seen in men. Those who had non-musculoskeletal comorbidity were more likely to have low back pain than those who had no comorbidity. Blue-collar workers, the self-employed, or farmers among men and blue-collar workers, the self-employed, or the jobless among women were significantly more likely to report low back pain

Table 2-2. Prevalence rates and age-adjusted and multivariate odds ratios (OR) with 95% confidence intervals (95% CI) for low back pain in women

Factor	Category	No. with			Age-adjusted		Multivariate	
		Total	low back pain	%	OR*	95% CI	OR**	95% CI
Cigarettes (No./day)	Never	3,035	1,890	62.3	1.00		1.00	
	1–20	381	252	66.1	1.18	(0.95, 1.48)	1.21	(0.90, 1.62)
	21+	54	39	72.2	1.60	(0.87, 2.92)	1.02	(0.50, 2.06)
Alcohol consumption	Never	2,002	1,255	62.7	1.00		1.00	
	Light drinker	1,505	946	62.9	1.01	(0.88, 1.16)	0.86	(0.72, 1.02)
	Heavy drinker	107	76	71.0	1.47	(0.96, 2.26)	1.16	(0.69, 1.95)
Physical exercise	Hardly ever or never	2,084	1,346	64.6	1.00		1.00	
	Often or sometimes	1,508	915	60.7	0.84	(0.73, 0.97)	0.87	(0.74, 1.04)
Body mass index (kg/m^2)	<21	993	588	59.2	1.00		1.00	
	21–22.99	1,016	624	61.4	1.10	(0.92, 1.31)	1.14	(0.91, 1.42)
	23–24.99	785	529	67.4	1.42	(1.17, 1.73)	1.41	(1.11, 1.80)
	25+	792	520	65.7	1.31	(1.08, 1.59)	1.28	(1.00, 1.63)
Non-musculoskeletal disease	No	2,203	1,263	57.3	1.00		1.00	
	Yes	1,096	755	68.9	1.70	(1.45, 1.99)	1.58	(1.31, 1.91)
Education	Compulsory	1,286	830	64.5	1.00		1.00	
	High-school	1,555	983	63.2	0.95	(0.81, 1.11)	1.00	(0.82, 1.22)
	Post-secondary	636	389	61.2	0.87	(0.71, 1.06)	0.94	(0.73, 1.22)
Occupation	White-collar	540	306	56.7	1.00		1.00	
	Blue-collar	137	96	70.1	1.79	(1.20, 2.68)	1.89	(1.21, 2.96)
	Self-employed	1,239	796	64.2	1.38	(1.12, 1.69)	1.47	(1.17, 1.86)
	Farmer	29	21	72.4	2.02	(0.88, 4.66)	1.73	(0.68, 4.42)
	Jobless	913	580	63.5	1.34	(1.07, 1.67)	1.40	(1.09, 1.79)
Living with parents	No	2,815	1,771	62.9	1.00		1.00	
	Yes	758	484	63.9	1.06	(0.88, 1.26)	1.20	(0.96, 1.50)
Living with a child or children	No	1,416	867	61.2	1.00		1.00	
	Yes	2,157	1,388	64.3	1.17	(1.01, 1.35)	1.20	(0.99, 1.46)
Living alone	No	3,298	2,083	63.2	1.00		1.00	
	Yes	275	172	62.5	0.97	(0.75, 1.25)	1.14	(0.80, 1.63)

*: Odds ratios were adjusted for age. **: Odds ratios were adjusted for age, cigarettes smoked per day, alcohol consumption, physical exercise, body mass index, non-musculoskeletal disease, education, occupation, and whether or not living with parents, living with a child or children, and living alone.

than white-collar workers in the age-adjusted model and in both models, respectively. Low back pain was also associated with living with a child or children in both men and women. There were negative associations between low back pain and physical exercise, education, or living alone in men in the age-adjusted model not in the multivariate model. There was no association with alcohol consumption in either men or women.

Discussion

The association of smoking with low back pain was examined in this cross-sectional study by using data for 3,251 men and 3,640 women in a community-based cohort study. There was a positive association between cigarette smoking and low back pain even when the data were adjusted for potential confounding factors.

The question “Do you have low back pain?” elicited no information on period or intensity. The definition of low back pain in this study was subjective and psychology-oriented rather than diagnostic and medicine-oriented. The questions in our study are considered to ask about low back pain in the respondents from the present time to as much as several months previously. In addition, the percentages of often having low back pain were 18.8% in men and 17.9% in women (the data are not shown in Table 1), which are close to the point prevalence rates[1, 12]. A problem in most epidemiological studies of low back pain is the non-specificity of this symptom. Even so, it is important to assess and evaluate self-reported low back pain in order to improve the health status of a population[13].

Moreover, not only the number of cigarettes smoked

per day but also the years of smoking may be necessary to estimate the exposure and effect of smoking on chronic non-specific low back pain. The statistical relationship between cigarette smoking and low back pain may be influenced by confounding factors, such as socioeconomic or psychological factors not included in the present study. The association between low household income and low back pain was reported in a preceding study[14].

The respondents in this study differed from the non-responders in age and gender composition. This may have had little influence on the results due to the high response rate[8]. This study may, however, have included a kind of selection bias because the sampling method was to choose a part of a city. It is possible that the generalizability was decreased because we tried to lower the non-response bias. In spite of including various issues, this study could be a meaningful one in terms of a larger sample of the general population, whose data have not been analyzed very much and reported in Japan.

The association between smoking and low back pain has mostly been investigated in cross-sectional studies in western populations and the results have been fairly consistent[14–16]. Goldberg *et al.*[5], however, reviewed 38 epidemiologic studies on the relationship between smoking and low back pain and found that smoking seemed to be associated with the incidence and prevalence of non-specific back pain, though it could not be ruled out that the association is a statistical artifact arising from either selection bias or confounding factors because the evidence for non-specific low back pain derives mostly from cross-sectional studies. Moreover, Leboeuf-Yde[17] conducted a systematic review of the 47 epidemiologic studies on smoking and low back pain and concluded that the association between smoking and low back pain was usually weak and clearly shown only in large study samples[18], and smoking should be considered a weak risk indicator and not a cause of low back pain. The significant result of our study may have been due to a larger sample.

Scott *et al.*[16] conducted a comparative study on smoking and low back pain in patients with adolescent idiopathic scoliosis (AIS) and controls and found a closer association in the AIS group than in the control group. Eriksen *et al.*[19] showed the odds ratios for heavy physical work were higher in smokers than in non-smokers in the incidence of low back pain in a community-based four-year prospective study, so that it could be inferred that smoking was a factor modifying the association between low back pain and other factors such as having a damaged spine or heavy workloads. Anyway, more longitudinal studies with larger sample, clearer definitions of low back pain, more precise estimation of exposure to smoking and more appropriate adjustment for potential risk factors will be needed in order to clarify the association between smoking and low back pain.

A number of plausible biological mechanisms have been suggested to explain the association. Smoking is associated with low bone density. It was reported that for every 10 pack-yr the bone mineral density of a twin who smoked more heavily was lower than that of the other twin[20]. Smoking as measured over the past 10 yr has had a negative effect on bone mineral density in young adult men[21]. Smoking reduces vertebral blood flow by some mechanisms working in concert. The plausible mechanisms are carboxyhemoglobin formation, vasoconstriction, arterial atherosclerosis, fibrinolytic defect, and hemorheological impairment. When vertebral bodies and intervertebral discs receive decreased blood supply, it can lead to depressed levels of oxygen and nutrients in these components, which makes them vulnerable to mechanical stress that is one cause of low back pain[22].

Those who had non-musculoskeletal comorbidity were more likely to complain of low back pain than those who had no comorbidity. Previous studies showed that low back pain was more prevalent among those with non-musculoskeletal comorbidity[15]. Atherosclerotic changes in the lumbar arteries, for example, are more likely to be found in those with low back pain than in those without low back pain[23], so that those who had low back pain might be more susceptible to, for instance, cardiovascular diseases at the same time[24].

In the present study, the prevalence of low back pain showed a downward trend with age in men. The association with age was not consistent in previous studies and had been discussed insufficiently[1, 2, 15, 18]. The extent to which those with low back pain report the symptom may differ among age groups. The question regarding low back pain in our questionnaire might be a little vague in this study[3, 25].

Body mass index in women was positively associated with low back pain but not in men. In a previous study, compared with women whose body mass indices were lower than 25 kg/m^2, those with body mass indices of 30 kg/m^2 or higher were 1.5 times more likely to have symptoms of intervertebral disk herniation[26]. According to Leboeuf-Yde *et al.*[27], however, because the association between body mass index and low back pain was weak and there is no consistent positive linear trend, it was unlikely that this association was causal. It seems that the role of body mass index in women differs from that in men in relation to low back pain, as seen in this study.

It was consistent with previous studies that social factors such as educational background and occupation were associated with low back pain in the present study[14, 28]. It was demonstrated that those with lower or no formal education were more likely to complain of low back pain than those with higher education. Just as in this study, blue-collar workers and farmers significantly tended to

report low back pain more than white-collar workers[28].

Low back pain in blue-collar workers has been investigated in many studies. Bricklayers working longer than 10 yr[29] and carpenters[7] were more likely to have low back pain than other kinds of construction workers in cross-sectional studies. Furthermore, occupational activities involving handling heavy weights or lengthy periods of standing or walking were associated with the occurrence of low back pain in a longitudinal study[30]. The exposure to whole-body vibration is also a factor that is related to the occurrence of low back pain in drivers of lorries, fork-lift trucks, tractors, cranes, loaders and buses[31, 32].

Skov *et al.*[33] reported that job demands, job controls, and supports in the job as psychosocial risk factors were associated with low back pain in sales people as white-collar workers. Hartvigsen *et al.*[34] reviewed 35 reports and concluded that recent epidemiological literature did not support the opinion that sitting-while-at-work was associated with low back pain.

There are few studies regarding association of self-employment with low back pain in contrast to blue-collar or white-collar workers. Studies on health status have been conducted on the self-employed. Hirose *et al.*[35] reported that self-employed with longer working hours a day carried their exhaustion over to the next day and did not have regular health examinations. Ohta *et al.*[36] clarified the difference in subjective symptoms and psychological complaints in different occupations by means of the Todai Health Index (THI)[37, 38] and reported that self-employed had more respiratory symptoms and higher score of impulsiveness than white-collar workers, and had the highest job difficulty and satisfaction among other occupation workers.

Participants living with their children were more likely to report low back pain than those living with no children. The preceding studies showed association between familial environmental stressors, with regard to family relationships and system maintenance, measured by the Family Environment Scale and low back pain[39, 40]. Unfortunately, it was not possible to discuss the effect of living with children on low back pain, because psychological aspects of family relationships were not investigated in our study.

Without doubt evidence based not only on cross-sectional but also prospective studies is needed in order to clarify risk factors in low back pain, in addition to smoking. Furthermore, studies on the effect of intervention in the potential risk factors for the occurrence of low back pain is needed to promote the health of the general population and the workplace.

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