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WIDESPREAD MUSCULOSKELETAL CHRONIC PAIN ASSOCIATED WITH SMOKING

AN EPIDEMIOLOGICAL STUDY IN A GENERAL RURAL POPULATION

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ABSTRACT. Data on smoking and pain symptoms from a random sample ($n = 1806$) of a general population were used to evaluate the association between chronic pain at various locations and smoking. In both genders current smoking was associated with reports of increased pain in low back, neck and with multiple locations. In a multiple logistic regression analysis current smoking was associated with an increase in widespread chronic musculoskeletal pain (OR 1.60, CI 1.04–2.46, in relation to non-smokers) and chronic low back pain (OR 1.58, CI 1.13–2.20, in relation to non-smokers). A dose-response relationship was found between the daily cigarette consumption and the prevalence of chronic low back pain. Smoking is associated not only with low back pain but also with chronic widespread musculoskeletal pain. No conclusive decrease in pain prevalence was found after quitting smoking. Further studies are necessary to elucidate an aetiologic relationship between smoking and chronic pain.

Key words: chronic pain; epidemiology; low back pain; smoking; widespread pain.

INTRODUCTION

Chronic pain of the musculoskeletal system is a common problem both in an unselected population (1) and in the healthcare system (11). About 10% of the individuals in a general population have a need for medical care because of chronic pain (5). Therapeutic and preventive measures could diminish personal suffering and the rising expenses for society. Prevention, however, is a major challenge in the light of the fragmentary knowledge of the origin of chronic pain.

Several factors are important in the development of chronic musculoskeletal pain. Specific injuries, diseases and physical overload can start a pain process where constitutional, psychosocial and lifestyle factors may modulate and aggravate the prognosis (22, 28, 29).

The use of tobacco, especially smoking, was established several years ago as a risk factor for cardiovascular disease, chronic obstructive pulmonary disease, a spectrum of malignancies and osteopenia (17, 25), but concerning chronic musculoskeletal problems an association between smoking and low back pain was not described until the late 1970s (10).

In further studies it has been proved epidemiologically that cigarette smoking is (7, 9) or is not (3) a risk factor for low back pain. A meta-analysis showed that 13 out of 24 studies supported an association between smoking and low back pain (15). Studies of other pain locations in relation to smoking are rare, and earlier studies have not considered any association between smoking and widespread musculoskeletal pain. Different possible reasons for an aetiological connection have been discussed for low back pain. Experimental studies confirm that smoking can induce malnutrition of the intervertebral discs due to an impaired microcirculation and in that way make them more vulnerable to mechanical stress (8). Coughing associated with chronic smoking has been proposed as a factor that could worsen back pain and raise the pressure on the discs. Nicotine has pharmacological effects in the central nervous system leading to inhibition of the pain-modulating systems of the brain stem (13). Against this background, tobacco use ought to be associated with more generalized pain syndromes. In an epidemiological study we found (2) a tendency towards more smokers among individuals with generalized pain compared with controls and individuals with neck-shoulder pain. Our hypothesis was that not only low back pain but also musculoskeletal pain in other sites may be associated with smoking and therefore the

purpose of this cross-sectional study was to search for associations between smoking and chronic pain. We also sought to estimate the effect of quitting smoking on the prevalence of chronic pain.

MATERIAL AND METHODS

As a part of an epidemiological study of chronic pain in two well-defined areas in the south of Sweden, a mailed survey was carried out. A questionnaire was sent to 1806 individuals, aged 25–74 years, randomly chosen from a population register, 15% of the population in the study areas. The response rate was 89.9%. The entire study is described elsewhere (1). In this paper, questions measuring chronic pain at different locations, other symptoms, socioeconomic and educational level, nicotine habits were used together with demographic data. Questions were asked about nicotine habits (current smoker, former smoker, never smoked, taking snuff) as well as the daily quantity of tobacco and the duration of the habit. Pain localization and duration were referred to by a pain drawing. Intensity for each location was shown on a graded pain scale with five precoded steps. The scale was numbered 1 to 5, and the endpoints of the scale were indicated by the words weak (= 1) and intense (= 5). Other symptoms during the previous three months were captured using a standard symptom list (2). Socioeconomic level was grouped according to a method used by Statistics Sweden, mainly based on trade union affiliation. We used four levels of education, from comprehensive school (8–9 years) to university. Work strain was reported according to five pretested questions and thus graded 0 to 5, where 0 implied no physical work strain and 5 the highest physical work strain (26). To study the influence of smoking on different individual chronic pain patterns, a clustering procedure using pain localization and pain duration was followed. In this way three groups were created:

I. Low back pain: chronic pain (duration >6 months) in low back (intensity 3–5) with or without radiating pain in the legs; $n = 223$.
II. Neck-shoulder pain: chronic pain (duration >6 months) in neck and/or shoulder (intensity 3–5) with or without pain in the arms; $n = 171$.
III. Widespread pain: chronic pain (duration >6 months) at more than three locations (intensity 3–5) $n = 228$.

Statistical methods

A χ^2 test was used to compare the pain prevalence and the tobacco habits. Correlations between pain prevalence and hypothetical aetiological factors were expressed as Spearman rank correlation coefficients.

Factors with a significant ($p < 0.01$) correlation were used in a multiple logistic regression model with pains of different locations as the dependent variables. Variables included in the analysis were dichotomized using dummy variables with the exception of age, socioeconomic level and smoking, which were categorized in the analysis.

The level of significance was set to 0.05 except for the correlations where the level of significance was 0.01 due to the large number of tests. For all statistical procedures, we used SPSS for Windows 6.1.

RESULTS

Tobacco habits

Daily smoking was reported by 28.5% of the population (29.9% males, 25.7% females). Among young women, smoking was more common than among men of the same age. At higher age levels in both genders smoking was less common than at lower ages (Table I). Taking oral snuff was exclusively a masculine habit, with an occurrence of 18.8% among men. Snuffing was found in 20.0% of the male smokers, in 24.0% of male former smokers, and in 11.0% of men who had never smoked. The number of years that the individuals had smoked

Table I. *Smoking habits by age, gender and socioeconomic level*

		Current smokers (%)	Duration Years, mean	Cigarettes/day Mean	Former smokers (%)	Never smoked (%)
Men	25–34	30.2	14.3	13.4	26.2	43.6
	35–44	34.9	23.1	15.6	34.0	29.7
	45–54	29.3	41.2	15.0	47.9	21.6
	65–74	20.7	48.2	13.9	43.0	32.6
Women	25–34	34.6	14.1	12.1	26.4	39.0
	35–44	32.2	22.1	13.9	28.8	37.0
	45–54	30.8	29.5	14.1	19.2	47.1
	55–64	17.4	37.1	10.1	17.4	60.4
	65–74	10.8	42.9	9.2	11.5	70.3
Socioeconomic level*						
	Blue-collar	31.5	24.6	13.7	31.3	36.6
	White collar	22.8	23.2	12.7	33.3	43.9
	Farmer	18.8	17.5	7.4	19.6	57.8
	Employer	31.9	21.3	13.8	28.0	40.2

* Figures standardized for age and gender. Total sample used as standard population.

Table II. *Report (%) of chronic pain (duration >6 months) by location, gender and smoking habits*

	Men			Women		
	Current smokers $n = 238$	Former smokers $n = 308$	Never smoked $n = 239$	Current smokers $n = 207$	Former smokers $n = 170$	Never smoked $n = 402$
Head, face	8.0	6.8	5.4	10.6	5.3	7.0
Neck	17.2*	16.6	9.2	22.7*	19.4	16.2
Shoulder	18.1	21.1	13.0	24.6	24.1	20.0
Arm, hand	8.4	11.4	5.4	20.8	17.6	14.7
Abdomen	5.9	4.9	2.1	5.8	4.7	3.7
Chest	7.1	5.8	4.6	8.7	8.2	6.0
Low back	27.7*	26.0	17.2	30.0*	24.7	19.2
Hip, thigh	10.5	10.7	7.5	16.4	12.9	13.5
Knee	15.5	15.3	11.3	14.5	12.4	11.5
Shank, foot	9.2	10.7	7.5	13.5	14.1	10.0
Other location	2.1	1.0	2.9	2.9	2.4	0.7
Multiple location[1]	12.1*	13.6	5.9	21.7*	15.3	12.7

* Difference between all three groups, $p < 0.05$, χ^2 test.
[1] Multiple location defined as more than three locations.

increased by age, as might be expected, but with no difference in gender. The mean number of cigarettes smoked in a day was lowest among the youngest and oldest age groups but with a difference between genders (Table I). Among blue-collar workers daily smoking was more common than among white-collar workers and farmers (31.5% vs 22.8% and 18.8%, respectively; $p < 0.01$ for both comparisons). The proportion of employers who were smokers was similar to that of blue-collar workers (31.9%).

Smoking—pain prevalence

For current smokers, former smokers and non-smokers, pain prevalence by location was compared assuming there would be no difference in prevalence (Table II). Chronic pain in neck, low back, and in multiple locations was for both genders more common among current smokers than among individuals who had never smoked ($p < 0.05$). Gender differences in pain prevalence in relation to smoking were found solely with pain of multiple location. At most locations former male smokers had pain prevalences as high as those of current smokers.

The group of men taking snuff was analysed separately in relation to the individual smoking habits. The prevalence of chronic pain was, with coincident snuffing, 56.7% for current smokers, 56.5% for former smokers and 35.9% for those who had never smoked. The corresponding figures with no snuffing were 53.6%, 52.5 and 43.8, respectively. No difference in pain prevalence by snuffing was found in these comparisons. In the further analysis, snuffing habits were not taken into consideration.

When the defined pain groups were studied in relation to smoking habits (Table III), we found more individuals with low back and widespread pain among current smokers. Former smokers had pain prevalences as high as those of current smokers. For low back pain there was a trend toward raised pain prevalence with increasing daily cigarette consumption.

To reduce the influence of socioeconomic factors and work strain on pain prevalence, we related chronic pain reports to smoking habits within the blue-collar group (Table IV). Between permanent smokers (daily smoking for more than five years) and non-smokers we found differences in gender and work strain. Despite standardizing for these factors and ages, individuals who had been daily smokers for at least five years more often reported low back pain and widespread pain compared with individuals who had never smoked. Prevalence of neck-shoulder pain did not differ between the groups. Subgroup analysis revealed that males aged 35–55 years made up the major part of the difference. Smokers of both genders frequently reported problems of depression and increased tension.

Multivariate analysis

To study the influence of different aetiological factors on

Table III. *Prevalence (%) of low back pain, neck-shoulder pain and widespread pain (groups I–III) in relation to smoking habits*

	Low back pain	Neck-shoulder pain	Widespread pain
Current smokers			
Total ($n = 445$)	16.0*	10.3	17.3*
1–9 cigs ($n = 127$)	14.2**	7.9	17.3
10–19 cigs ($n = 200$)	15.0	12.5	18.5
>20 cigs ($n = 118$)	22.9	9.4	15.3
Former smokers ($n = 478$)	15.3	12.3	15.7
Never smoked ($n = 641$)	12.0	9.7	10.9

* Difference between current smokers and never smoked, χ^2 test, $p < 0.05$.
** χ^2 test for trend, $p < 0.05$.

chronic pain, a broad correlation analysis was carried out including a large number of hypothetical predictive variables. These variables were used in calculating odds ratios (OR) expressing the risk of chronic pain at different locations in a logistic multiple regression analysis (Table V). Increasing age, female gender, low education, high work strain, current smoking and symptoms of melancholy, difficulties in relaxing and sleep disturbances appeared to be explanatory factors for pain at all locations. Current smoking increased the risk of low back pain (OR 1.58, 95% confidence interval (CI) 1.13–2.20) and widespread pain (OR 1.60, CI 1.04–2.46) compared with those who had never smoked. Former smokers showed the same pattern of raised OR of low back (1.66 CI 1.19–2.32) and widespread pain (1.59 CI 1.05–2.43) in relation to non-smokers. Neck-shoulder pain was not associated with current or previous smoking. A high work strain resulted in increased OR for all pain locations. Psychic symptoms such a depression (OR 1.93, CI 1.30–2.87), difficulties in relaxing (OR 1.97, CI 1.32–2.93) and sleep disturbances (OR 1.60, CI 1.10–2.33) as well as fatigue (OR 1.63, CI 1.06–2.49) were associated with widespread pain. Although obesity, restlessness and nervousness showed a univariate correlation to chronic pain, the association disappeared for all locations in the multivariate analysis.

DISCUSSION

One of the main outcomes of this study is the correlation between widespread pain and daily smoking. Few studies describe pain locations other than the low back region in relation to smoking. This issue was discussed in a recent Icelandic survey of 862 individuals of a general population (16). Male smokers reported pain problems more often than females, but back pain was the sole location more prevalent among former and current smokers than among non-smokers. In a further analysis, smokers displayed more intervertebral disc problems

Table IV. *Comparison of symptoms and pain prevalence between blue-collar, long-term smokers (at least 5 years' duration) and blue-collar workers who had never smoked*

	Long-term smokers ($n = 239$)	Never smoked ($n = 256$)
Age (median, years)	43.0	49.5
Female gender (%)*	47.7	60.5
Work strain (%)[1]* 0	15.9	22.6
1	17.6	20.7
2	21.7	23.4
3	18.8	18.8
4	18.8	10.2
5	7.1	4.3
Symptoms (%):		
Feeling depressed*	33.4	19.5
Difficult to relax*	30.5	20.7
Nervousness	13.0	9.0
Sleeping disturbances	21.8	21.1
Chronic pain symptoms (%):[2]		
Low-back*	17.6	12.9
Neck-shoulder	10.2	12.3
Widespread*	22.6	13.5
All locations*	68.6	56.3

[1] Work strain graded from 0 (= low strain) to 5 (= intense strain).
[2] Prevalence figures of pain groups I–III and chronic pain of all locations and intensities, standardized by age, gender and work strain, total blue-collar group used as the standard population.
* Difference between long-term smokers and never smoked, χ^2 test $p < 0.05$.

Table V. *Odds ratios (95% confidence interval) for determinants of chronic pain (>6 months) of all locations (independent of intensity), low back, neck-shoulder and widespread located (groups I–III). Results from a logistic regression modelling of variables showing a univariate correlation to chronic pain report independent of location*

	All locations	Low back	Neck-shoulder	Widespread
Age 25–44	1.00	1.00	1.00	1.00
45–64	2.13 (1.64–2.78)	1.78 (1.32–2.39)	1.47 (1.00–2.16)	3.10 (2.08–4.61)
65–74	1.94 (1.34–2.79)	1.71 (1.11–2.63)	1.25 (0.72–2.17)	3.82 (2.22–6.61)
Female gender	1.30 (1.01–1.66)	1.14 (0.86–1.51)	1.18 (0.82–1.70)	1.87 (1.31–2.68)
Living with a partner	1.79 (1.29–2.46)	0.97 (0.68–1.38)	2.43 (1.33–4.44)	1.03 (0.66–1.58)
Socioecomic level				
Blue–collar	1.00	1.00	1.00	1.00
White–collar	0.73 (0.54–1.02)	0.89 (0.60–1.32)	0.98 (0.60–1.61)	0.52 (0.31–0.88)
Farmer	0.64 (0.37–1.11)	0.98 (0.53–1.82)	0.48 (0.17–1.38)	0.61 (0.26–1.38)
Employer	0.75 (0.51–1.09)	0.79 (0.56–1.09)	1.34 (0.79–2.30)	0.54 (0.29–0.99)
Education (>9 years)	0.51 (0.39–0.68)	0.79 (0.56–1.09)	0.67 (0.43–1.03)	0.82 (0.53–1.25)
High work strain (3–5)	2.54 (1.89–3.42)	2.39 (1.78–3.23)	1.37 (0.92–2.04)	2.72 (1.89–3.92)
Smoking				
Never smoked	1.00	1.00	1.00	1.00
Former smoker	1.24 (0.92–1.65)	1.66 (1.19–2.32)	1.19 (0.78–1.80)	1.59 (1.05–2.43)
Current smoker	1.33 (1.01–1.77)	1.58 (1.13–2.20)	0.92 (0.59–1.42)	1.60 (1.04–2.46)
Report last 3 months of:				
Sleep disturbances	1.80 (1.30–2.49)	1.08 (0.77–1.65)	1.86 (1.24–2.80)	1.60 (1.10–2.33)
Feeling depressed	1.56 (1.13–2.16)	1.47 (1.05–2.05)	0.76 (0.47–1.23)	1.93 (1.30–2.87)
General fatigue	1.33 (0.94–1.86)	1.55 (1.09–2.19)	0.61 (0.36–1.04)	1.63 (1.06–2.49)
Relaxation difficulties	1.60 (1.16–2.21)	1.65 (1.19–2.30)	1.53 (0.98–2.38)	1.97 (1.32–2.93)

Variables also tested in the logistic regression model: feeling restless, nervous complaints, physical exercise, feeling irritable, body mass index.

than ex-smokers. In agreement with our results, a Norwegian survey of 6681 individuals aged 16–66 years found that smoking was associated with pain in low back, cervical/upper limb and lower limb after adjustment for gender, age, mental distress, lifestyle and occupation-related factors (4). No results for widespread pain were presented but the study concluded that musculoskeletal pain was often present in more than one location. Locations with high pain prevalence were often associated with smoking, but our study shows frequent pain locations (shoulder, knee, hip) that are not associated with smoking.

Fibromyalgia, which can be regarded as a subgroup of widespread pain, has not shown any association with smoking in most epidemiological studies (20).

Low back pain and smoking have been discussed in several studies since the late 1970s. Many epidemiological studies, both retrospective and prospective, have indicated this relationship with varying degrees of reliability. In a survey of 1221 men aged 18–55 years attending a family practice in the USA, individuals with severe low back pain frequently were smokers and had a greater tobacco consumption than those without pain (9). A dose-response relationship, which we found for the number of cigarettes in relation to low back pain, has been proved earlier (7).

In a longitudinal study of women from the Netherlands (27), low back pain was associated with smoking at the outset of the study but smoking was not predictive of low back pain nine years later. Our findings suggest that the connection between smoking and low-back pain is strongest in middle-aged men. This is in accordance with another Swedish study of a random sample of a general population where men aged 50–59 years with low back pain smoked more than those without (24). For females and other male age groups no difference was found. On the other hand, national survey data from the USA reported the strongest associations between low back pain and smoking in persons younger than 45 years (7). In that study the prevalence of back pain also rose with increasing obesity, smoking and obesity being independent risk factors. In a large study of prevalence and consultations for back pain in England, both smoking and obesity were positively correlated to low back pain at all ages (29). Our results support the importance of smoking but not obesity as risk factors for low back pain.

A meta-analysis of the association between smoking and low back pain showed that 13 studies out of 24 established a connection between the factors, but the association remained in only 8 studies after a multivariate analysis (15). The studies did not support the hypothesis that smoking is a causal factor of disc herniation or sciatica. Working conditions and marital status had the greatest impact on reducing the association. These factors were also important in our study but the link between smoking and pain remained after the analysis.

The representativeness of our results should be critically discussed from different angles. The design of the study is cross-sectional, which makes relationships more difficult to interpret. On the other hand, the high representativeness of a general population is powerful, with a small number of dropouts having an age and gender distribution close to that of the total population (1), which makes generalization of results possible. Despite this study design we have longitudinal exposure data on the smoking period and the relation between the onset of smoking and pain experience. The start of the smoking period always preceded the reported onset of pain symptoms, but the amount of tobacco used could have changed during the period. Individuals with sporadic cigarette consumption ("party-smokers") could be misclassified as non-smokers from our questions about smoking habits. The low level of exposure of smoking among those individuals compared with daily smokers could not significantly influence the results.

Smoking habits are related to age, gender, personality, socioeconomic level and lifestyle habits (e.g. physical exercise, diet and alcohol) (23), as is partly displayed in our findings. The associations between pain and smoking could be due to one such common personality: prone to develop both pain symptoms and tobacco abuse. In the multivariate analysis, personality factors and possible confounders were studied in relation to smoking. The importance of smoking as a contributory factor for low back and widespread pain still remained. However, the explanatory potential of all studied factors was moderate, which might endorse a very complex aetiological pattern for chronic pain.

A low level of physical exercise and poor physical fitness are associated with smoking (6) and have also been proposed as contributory factors in the genesis of chronic pain. Smoking could therefore be a marker of this connection. In our analysis exercise habits had no explanatory value for the model.

Several theories have been proposed regarding a causal relationship between smoking and low back pain. The most recent (8) relies on the findings of lowered nutrition of intervertebral discs because of impaired circulation due to smoking. Protracted coughing and an elevated risk of osteoporosis among smokers are other factors discussed in relation to back pain (14).

Circulatory factors may also be important in the genesis of widespread pain . Vasoconstrictive properties of nicotine and an increased level of CO-haemoglobin in the circulation are factors that could impair the nutrition of a tense muscle (12). Osteoporosis, most frequent among postmenopausal women (14), may contribute to widespread pain experience in elderly smokers . Our results showed an increased risk of widespread pain by age, something that could support the hypotheses of vasoconstriction and osteoporosis as associated factors.

Nicotine has traditionally been described as having both a central stimulating effect on the nervous system and calming, pain-reducing outcomes. Pain thresholds in relation to smoking have been studied with partly divergent results. In an experimental study with responses to electrical stimulation, males tended to increase their pain threshold after smoking (19). In contrast, a study of ischaemic pain onset and tolerance (blood pressure cuff) suggested that smokers had a faster pain onset and a shorter tolerance period than non-smokers (18). The antinociceptive (cold pressor test) and calming effects of smoking were also demonstrated in a study by using cigarettes, either containing nicotine or nicotine-free (21). These results, although not uniform, make it possible to relate nicotine to specific effects that could explain a changed nociception or a sensitization of the central nervous system. However, our finding, that there is no effect of taking snuff on the risk of pain symptoms, contradicts the hypothesis that nicotine alone plays a role in the pathogenesis of chronic pain.

To sum up, there are several plausible physiological hypotheses that may link smoking to chronic pain not only located in the low back but also in multiple locations. Our findings concerning low back pain and smoking are supported by earlier studies and a dose-response relationship. The lack of these circumstances with respect to widespread pain may point to different causal connections.

Convincing people of the importance of giving up smoking is an important and established preventive measure for several diseases. From our study and others that have demonstrated an association between smoking and chronic pain, it could be argued that individuals with low back pain and possibly with widespread pain may

also benefit from quitting smoking. The results of our study, however, describe no decrease in pain prevalence among former smokers compared with current smokers, a factor that is also mentioned in the Icelandic survey (16). This finding may reflect a poor prognosis of the pain syndrome per se or a certain pain-prone personality showing no improvement after quitting smoking. Prospective studies must elucidate whether never starting to smoke at all is the most successful way of decreasing the prevalence of chronic pain.

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