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Trends of Back Pain in Eastern Finland, 1972–1992, in Relation to Socioeconomic Status and Behavioral Risk Factors

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The aim of this study was to compare the trends in the prevalence of back pain between several population subgroups and to assess the stability of the associations between back pain and its potential risk factors. Five cross-sectional surveys with independent random samples were conducted in two provinces in eastern Finland every fifth year from 1972 to 1992. There were 29,043 respondents aged 30–59 years. The respondents completed a questionnaire that asked about the occurrence of back pain during the preceding month. The prevalence of back pain varied between 46 and 50 percent among men and between 46 and 51 percent among women. In general, the trend for the entire sample was fairly stable, but the prevalence rates seemed to differ considerably between subgroups of the population. Back pain was more prevalent among those with lower education and income, those with blue-collar occupations, and those doing heavy work. The trends were significantly inconsistent ($p < 0.05$), for example, between the categories according to household income and, among men, between the categories according to body mass index, a suspected risk factor for back pain. *Am J Epidemiol* 1998;148:671–82.

back pain; body mass index; education; income; occupations; smoking; workload

Back pain is a common and disabling condition among the general population of the industrialized world (1–7). The societal costs of back disorders are high (8) because of early retirement, sick leaves, and the frequent usage of health services (1, 2, 9–12). Yet, little is known about time trends in the prevalence of back pain (13, 14).

Socioeconomic factors affect health greatly, as has been shown in several studies from different countries: Finland (15–17), the Scandinavian countries (18–21), Britain (18, 19, 22), Germany (23), the Netherlands (24), the United States (25, 26), and Australia (27, 28). Socioeconomic status in general (2, 5, 6, 29) and, in particular, the degree of education (1, 30, 31) seem to be inversely associated with complaints of back pain.

The behavioral risk factors for back pain are numerous. Workload, particularly heavy lifting (32–34), is known to be associated with back trouble (2, 35, 36). Leisure-time physical inactivity (2, 32), high body mass index (2, 5, 33, 37, 38), and smoking (6, 32, 35, 39–44) are potential risk factors of back pain, although the evidence is somewhat controversial.

We now had the possibility of assessing back pain trends for various subgroups of the population by using our data from five cross-sectional surveys over a 20-year period (data that were initially collected for the evaluation of the North Karelia Project). The specific aims of this paper were to assess 1) the trends for prevalence of back pain in eastern Finland during 1972–1992, 2) the associations between back pain and education, household income, occupation, workload, leisure-time physical activity, body mass index, and smoking, and 3) the stability of these associations over the 20 years.

MATERIALS AND METHODS

The high coronary heart disease rates in Finland in the early 1970s (45) led to the launching of the North Karelia Project in 1972. The aim was to lower the coronary mortality rates in North Karelia by implementing a community-based program. The project collected data on cardiovascular disease risk factors, socioeconomic and psychosocial variables, medical history, health behavior, and perceived health.

Five comparable cross-sectional studies have been conducted every fifth year since 1972 in the eastern provinces of North Karelia and Kuopio, the latter being the primary reference area. For each survey, an independent random sample was drawn from the population register. In 1972 and 1977, a random sample of 6.6 percent of the population born between 1913 and

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1947 was drawn from the two provinces. In 1982, 1987, and 1992, the target population consisted of people between ages 25 and 64 years in the two areas, and in these three surveys, at least 250 persons of each sex and 10-year age group were randomly chosen for the sample in each area. This paper considers the age range 30–59 years, which the five surveys had in common. Sample sizes and participation rates are given in table 1, and more information on the demographics of the surveys is given in tables 2 and 3.

The surveys were carried out by mailing a questionnaire to the subjects. Thereafter, the respondents underwent a health examination given by a research team at the local health center. On the questionnaire, the subjects were asked if they had back pain or a backache during the preceding month. The answer alternatives were yes and no.

Education was measured as the total number of school years. Because the mean length and the structure of the Finnish education system has changed markedly during the 20th century, we divided the respondents into educational tertiles according to their birth years. For example, independent of the survey(s) in which they had taken part, those born in 1930 were divided into three educational groups sized as equally as possible according to the number of school years. The questionnaire defined "school years" as all education beginning with elementary school. The respondents were sorted into two groups by household income. They were asked to choose one of nine alternative income groups, determined by annual gross household income. The participants in each of the five surveys were then divided into two separate income groups of roughly equal sizes.

The respondents were asked what kind of work they did during most of the year and were classified into four groups according to occupation. The categories were: 1) farming, cattle tending, forest work, or housewife on a farm (later referred to as farmers); 2) work in a factory or in a mine, on construction, or corresponding work (later: blue-collar workers); 3) work in an office, nonmanual work, service work, or studying (later: white-collar workers). The fourth group (other occupations) was very heterogenous and was thus not included in the analysis. This exclusion was the reason why we did not include occupation in the combined logistic regression model along with the other variables. We also asked the subjects how physically demanding their work was. The categories were: 1) mainly sedentary work (later: sedentary); 2) work with plenty of walking, but no heavy lifting (later: walking); 3) work with plenty of walking and lifting (later: walking and lifting); 4) heavy physical work (later: heavy). Those who did not work were advised to choose the first alternative, i.e., sedentary.

The participants were sorted into three groups according to the average amount of physical activity during their leisure time: 1) reading, watching the television, and other tasks with low physical activity (later: low); 2) walking, bicycling, fishing, hunting, light gardening, etc., for at least 4 hours a week (later: moderate); 3) proper conditioning exercise, such as running, jogging, cross-country skiing, gymnastics, swimming, ball games, heavy gardening, or corresponding activities for at least 3 hours a week, or practicing hard several times a week for sports competitions (later: high). Furthermore, we divided the respondents into three categories according to body mass index (weight (kg)/height $(m)^2$): <25, 25–29.99, and ≥30 kg/m^2. Finally, the respondents were sorted into three smoking categories: never-smokers, ex-smokers, and current smokers.

The back pain prevalences in the figures were adjusted for age (except for figure 2 representing age groups), as categorized into three 10-year age groups. For this operation, the basic population was formed by combining all of the samples from the five surveys, with the two genders being pooled together. The statistical significance rates and the odds ratios were calculated by using logistic regression models (Wald chi-square test of the SAS program) (46). The odds ratios and p values given for different variables in tables 4 and 5 describe the difference between two (successive) categories of the variable concerned. For

TABLE 1. Samples and participation rates by survey year, sex, and area (age range, 30–59 years), North Karelia and Kuopio provinces, Finland, 1972–1992*

Survey year	Men				Women			
	North Karelia Province		Kuopio Province		North Karelia Province		Kuopio Province	
	No.	%	No.	%	No.	%	No.	%
1972	1,959	94	2,918	91	2,056	96	2,949	94
1977	2,063	87	2,933	89	2,020	91	2,996	92
1982	1,599	77	1,459	83	1,511	84	1,143	88
1987	1,521	79	762	82	1,485	87	744	87
1992	759	69	768	76	750	82	735	85

* Number of participants = 29,043.

TABLE 2. Subgroups, according to age, education, household income, occupation, workload, leisure-time physical activity, body mass index, and smoking, by survey year for men (in percentage), North Karelia and Kuopio provinces, Finland, 1972–1992*

Survey year	1972 (%)	1977 (%)	1982 (%)	1987 (%)	1992 (%)
Age (years)					
30–39	33	36	37	32	30
40–49	38	34	30	33	38
50–59	29	30	33	35	32
Education					
Low	24	24	29	31	29
Middle	38	38	36	33	32
High	38	38	35	36	39
Household income					
Lower	49	49	48	43	50
Higher	51	51	52	57	50
Occupation					
Farmer	33	24	23	19	14
Blue-collar	29	31	31	29	27
White-collar	25	29	32	33	40
Other	13	16	13	18	20
Workload					
Sedentary	25	30	31	34	42
Walking	19	23	23	22	22
Walking and lifting	22	22	22	24	25
Heavy	34	25	25	20	11
Leisure-time physical activity					
Low	34	30	31	28	20
Moderate	52	53	50	52	57
High	13	17	19	20	23
BMI† (kg/m²)					
0–24.99	43	41	37	32	36
25–29.99	46	47	48	49	44
≥30	11	13	15	19	20
Smoking					
Never-smoker	28	29	34	36	40
Ex-smoker	21	27	27	27	25
Current smoker	51	44	39	37	35
No. of participants	4,499	4,401	2,436	1,818	1,103

* Number of participants = 14,257.
† BMI, body mass index.

example, the values given for "survey year" describe the change in every 5-year period during the 20-year study period. The survey years were coded 1972 = 1, 1977 = 2, etc., for computing. The interactions (survey year × variable) in tables 5 and 6 from the logistic regression models were calculated to reveal the possible inconsistency in the associations of the variables with back pain. All of the models with interaction terms were adjusted for survey year and age (as a continuous variable, except for the model for 10-year age groups, where age is a categorical variable), and the variable concerned. Smoking, which was not an ordinal variable, was taken into the combined logistic regression model (table 4) in dummies.

RESULTS

The prevalence trends of back pain in different population subgroups in 1972–1992 are presented in figures 1–5, and the corresponding statistical data are given in tables 4–6. Nearly half of the study population reported back pain during the preceding month (figure 1). Over the 20-year period, the overall prevalence of back pain exhibited a downtrend (p = 0.0007) when the genders were assessed together. Controlled for age alone, the declining trend was statistically significant among men (p = 0.0011) but not among women (p = 0.099). The sex differences in the 20-year prevalence (p = 0.79), controlled for survey

TABLE 3. Subgroups according to age, education, household income, occupation, workload, leisure-time physical activity, body mass index, and smoking, by survey year for women (in percentage), North Karelia and Kuopio provinces, Finland, 1972–1992*

Survey year	1972 (%)	1977 (%)	1982 (%)	1987 (%)	1992 (%)
Age (years)					
30–39	31	33	34	33	33
40–49	36	33	31	33	36
50–59	33	34	35	34	31
Education					
Low	27	31	30	35	31
Middle	36	35	35	32	33
High	37	34	35	34	37
Household income					
Lower	50	53	53	45	53
Higher	50	47	47	55	47
Occupation					
Farmer	25	18	16	14	8
Blue-collar	8	10	11	11	8
White-collar	29	39	47	53	62
Other	38	33	25	23	22
Workload					
Sedentary	27	33	36	36	45
Walking	31	34	33	32	30
Walking and lifting	38	30	28	28	23
Heavy	4	4	3	4	2
Leisure-time physical activity					
Low	53	43	36	30	24
Moderate	38	46	50	55	58
High	9	11	14	15	18
BMI† (kg/m²)					
0–24.99	40	45	48	48	48
25–29.99	38	36	35	33	32
≥30	22	19	17	19	20
Smoking					
Never-smoker	87	84	77	73	69
Ex-smoker	3	5	8	11	14
Current smoker	11	11	15	15	18
No. of participants	4,742	4,601	2,271	1,939	1,233

* Number of participants = 14,786.
† BMI, body mass index.

year and age and in the 20-year trend ($p = 0.25$) were not statistically significant, however (table 5). The age group differences remained stable during 1972–1992 (figure 2, table 6).

Those with the highest level of education had significantly less back pain than did the groups with middle or low levels (figure 3, table 4). Because the two latter groups had such similar trends, the statistical comparisons given in tables 4 and 6 were made after the two groups were combined. The marked disparity in prevalence of back pain according to education existed consistently over the 20 years among both sexes (table 6). Low household income was inversely associated with back pain as well (figure 3, table 4). This disparity between the two income categories diminished during 1972–1992, however, and the interaction term of survey year and household income was statistically significant among both men and women (table 6).

Occupation and workload showed obvious and time-stable associations with back pain (figure 4, tables 4 and 6). Leisure-time physical activity was associated with less back pain among both sexes, but this association was more stable among men than among women, in whom the interaction term with survey year reached statistical significance (table 6). Body mass index was directly proportional to the prevalence of back pain among women, but not among men, even

TABLE 4. Odds ratios and *p* values for back pain for demographic, socioeconomic, and behavioral factors, from the same model, North Karelia and Kuopio provinces, Finland, 1972–1992*

	All			Men			Women		
	p value	OR†	95% CI†	*p* value	OR	95% CI	*p* value	OR	95% CI
Gender (female vs. male)	<0.0001	1.19	1.12–1.27						
10-year age group	<0.0001	1.27	1.23–1.32	<0.0001	1.36	1.30–1.43	<0.0001	1.17	1.12–1.23
Education‡	<0.0001	0.77	0.73–0.81	<0.0001	0.76	0.71–0.82	<0.0001	0.79	0.73–0.85
Household income	<0.0001	0.87	0.83–0.92	0.0062	0.90	0.83–0.97	<0.0001	0.84	0.78–0.91
Workload§	<0.0001	1.33	1.28–1.38	<0.0001	1.31	1.26–1.37	<0.0001	1.38	1.27–1.45
Leisure-time physical activity	<0.0001	0.88	0.85–0.92	<0.0001	0.85	0.81–0.90	0.0021	0.92	0.87–0.97
BMI†	<0.0001	1.10	1.06–1.14	0.052	1.05	1.00–1.11	<0.0001	1.16	1.10–1.22
Ex-smoker (vs. never-smoker)	<0.0001	1.27	1.17–1.37	<0.0001	1.30	1.18–1.43	0.0021	1.26	1.09–1.45
Current smoker (vs. never-smoker)	<0.0001	1.16	1.09–1.24	<0.0001	1.26	1.15–1.36	0.86	0.99	0.89–1.10

* Number of participants = 29,043.
† OR, odds ratio; CI, confidence interval; BMI, body mass index.
‡ Categories: high versus middle/low.
§ Categories: sedentary/walking, walking and lifting, and heavy.

TABLE 5. Odds ratios and *p* values for back pain for age (continuous variable), survey year, and gender, North Karelia and Kuopio provinces, Finland, 1972–1992*

Model†	Men			Women			All		
	p value	OR‡	95% CI‡	*p* value	OR	95% CI	*p* value	OR	95% CI
1									
Age	<0.0001	1.035	1.031–1.039	<0.0001	1.023	1.019–1.027			
Survey year	0.0011	0.957	0.932–0.983	0.099	0.979	0.954–1.004			
2									
Age							<0.0001	1.029	1.026–1.031
Survey year							0.0007	0.969	0.951–0.987
3									
Gender (female vs. male)							0.79	1.006	0.961–1.054
4									
Survey year × gender							0.25	1.022	0.985–1.060

* Number of participants = 29,043.
† Models 3 and 4 were adjusted for age (continuous variable) and survey year, and model 4 was adjusted for gender. The interaction term survey year × gender in model 4 describes the consistency in the association between back pain and gender over 20 years.
‡ OR, odds ratio; CI, confidence interval.

when controlled for the other risk determinants (figure 5, table 4). Yet, in 1987 and 1992, the body mass index category differences seemed to become obvious among men as well. The time trends between the categories of body mass index differed significantly from each other among men ($p = 0.021$), while no trend differences were observed among women ($p = 0.78$).

Male smokers and ex-smokers of both genders reported significantly more back pain than did never-smokers (table 4). Among men, this association was consistent over the 20 years (table 6). Among women, the trends were significantly different ($p = 0.042$) for never-smokers and ex-smokers.

DISCUSSION

During the 20 years of follow-up, a slight decrease in the prevalence of back pain was observed among men, while the prevalence remained stable among women. A substantial decrease was observed in both men and women who were in the lower household income category. In general, the prevalence rates seemed to differ considerably between subgroups of the population.

The consistency of replication can be considered a central criterion in testing epidemiologic evidence of disease causation. A causal association should remain in time within a given study design. Thus, our study not only offered a unique opportunity to compare time trends in the occurrence of back pain between population groups but also to test the stability of the associations between back pain and its suspected risk factors.

A low level of education, blue-collar occupations, and physical load at work had strong and time-stable

TABLE 6. Odds ratios and *p* values of the interaction terms of survey year and different variables, North Karelia and Kuopio provinces, Finland, 1972–1992*

	Men			Women		
	p value	OR†	95% CI†	*p* value	OR	95% CI
Model 1						
Survey year × 10-year age group	0.25	1.02	0.99–1.06	0.23	1.02	0.99–1.05
Model 2						
Survey year × education‡	0.12	1.05	0.99–1.11	0.54	1.02	0.96–1.07
Model 3						
Survey year × household income	0.020	1.07	1.01–1.13	<0.0001	1.13	1.07–1.19
Model 4						
Survey year × occupation	0.30	1.02	0.98–1.06	0.49	1.01	0.98–1.05
Model 5						
Survey year × workload	0.51	0.99	0.97–1.02	0.15	1.02	0.99–1.05
Model 6						
Survey year × leisure-time physical activity	0.16	0.97	0.93–1.01	0.049	1.04	1.00–1.08
Model 7						
Survey year × body mass index	0.021	1.05	1.01–1.09	0.78	1.00	0.96–1.03
Models 8–10						
Survey year × smoking	0.18	0.98	0.95–1.01	0.18	1.03	0.99–1.06
Survey year × never-smoker/ex-smoker§	0.63	1.02	0.95–1.09	0.042	1.11	1.00–1.24
Survey year × never-smoker/current smoker¶	0.14	0.98	0.95–1.01	0.42	1.02	0.98–1.05

* The interaction terms describe the consistency in the association between back pain and that variable in the course of 20 years. The models were adjusted for age (continuous variable, except in model 1), survey year, and the variable concerned.
† OR, odds ratio; CI, confidence interval.
‡ Categories: high and middle/low.
§ Current smokers excluded from the model.
¶ Ex-smokers excluded from the model.

associations with back pain among both sexes. The inverse association of household income and back pain weakened markedly between 1972 and 1992; among women, the disparity even seemed to disappear in 1992. Furthermore, back pain was, in a stable manner, determined by body mass index among women and by smoking among men. Toward the end of the follow-up period, high body mass index turned out to be a significant determinant of back pain among men as well.

In our study, the only way to measure back pain was through the self-reports given on the questionnaires. "Low back pain" is the term used to describe back pain complaints in most studies. In the Finnish language, however, the terms "back pain" or "backache" are common language and are understood as pain in the lumbar or thoracic back but not in the neck or shoulder region.

The way in which different persons express pain symptoms varies quite a lot, and psychologic factors (47) and cultural background (48), for example, have a role. The manner in which people express pain may

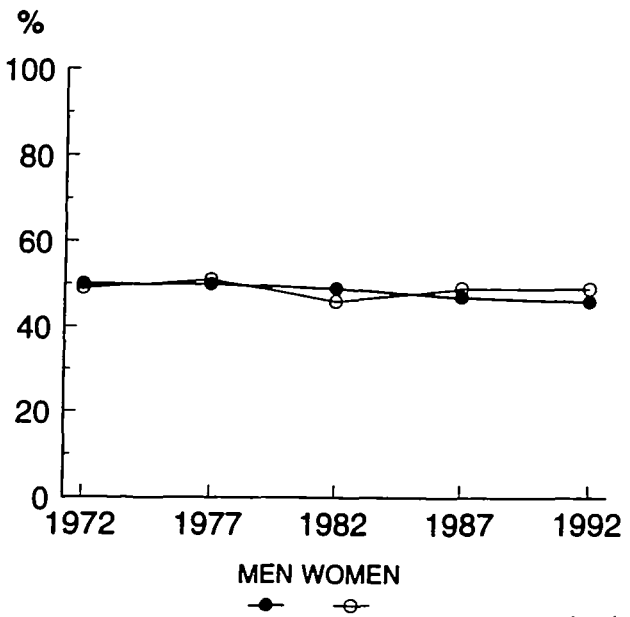

FIGURE 1. Age-adjusted prevalence rates of back pain during the preceding month among men and women in eastern Finland, 1972–1992.

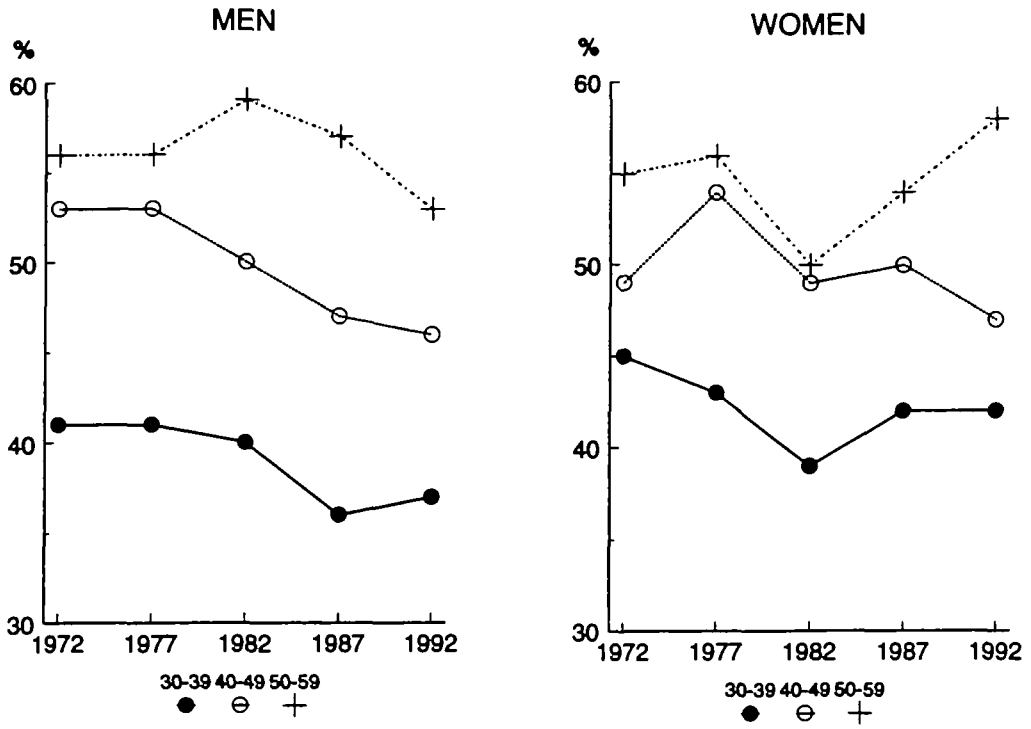

FIGURE 2. Prevalence rates of back pain during the preceding month among men and women in eastern Finland, 1972–1992, by age (in years).

even change with time, accompanied with changes in general health expectations and in the health care and social insurance systems. Our data from the five comparable, cross-sectional surveys, however, provide a new perspective on back pain trends over the 20 years.

In another Finnish follow-up study of the prevalence of back pain (13), the sample contained younger age groups than in our study, which probably partially explains the lower prevalence rates for back pain compared with those in our data. Neither that study nor ours revealed major, long-term changes in the prevalence rates for back pain. According to these papers, the societal costs caused by back complaints are not increasing because of increasing prevalence. A study among Finnish farmers aged 18–64 years even expressed diminishing trends of low back pain (14). In 1979, 71 percent of the men and 70 percent of the women had experienced back pain during the preceding year, and in 1992, the prevalences were 60 and 57 percent, respectively.

Socioeconomic status had a marked inverse relation with the prevalence of back pain. This confirms the results of several earlier studies (1, 2, 6, 29). The differences between income groups diminished markedly during the 20 years. The reason is unclear. Today, low level of education thus seems to be a stronger determinant of back trouble than does low household income. As a component of socioeconomic status, education is individual and does not change with time like occupations and income often do. Measurement by education also avoids the problems of comparability due to unemployment.

Our division into subgroups by education is not wholly unproblematic, although we avoided many biases by dividing the subjects according to their birth years. The overall educational level of the Finnish population has improved decisively during the second half of this century, which brings persons with a wide variety of years of schooling into the same educational group. The concept of household income, for its part, is not as personal an indicator as is education. Yet, household income is a better indicator in the cases of, for example, unemployed persons and housewives, than would be personal income. However, household income does not distinguish between households with the same income but a different number of persons.

Blue-collar occupations and physical workload were associated with increased prevalences of back pain as in several previous studies (2, 5, 32, 34–36, 49). However, those whose work was sedentary had slightly more back pain than did those whose work contained plenty of walking.

There has been a considerable improvement in the standard of living in Finland during the past 20 years. Heavy physical work is not as common today as it was in the 1970s. Thus, the concept of "heavy physical"

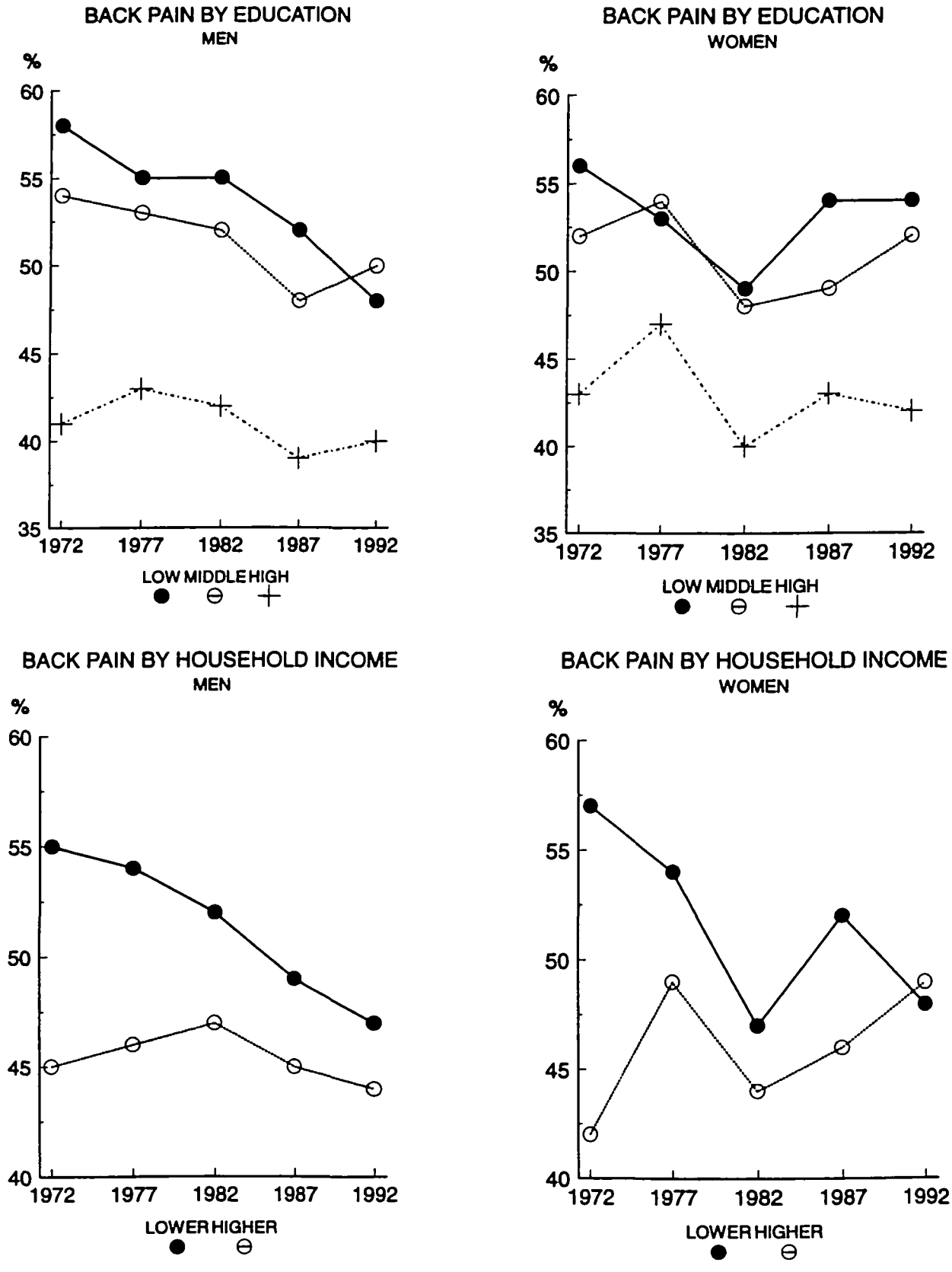

FIGURE 3. Age-adjusted prevalence rates of back pain during the preceding month among men and women in eastern Finland, 1972–1992, by education and household income.

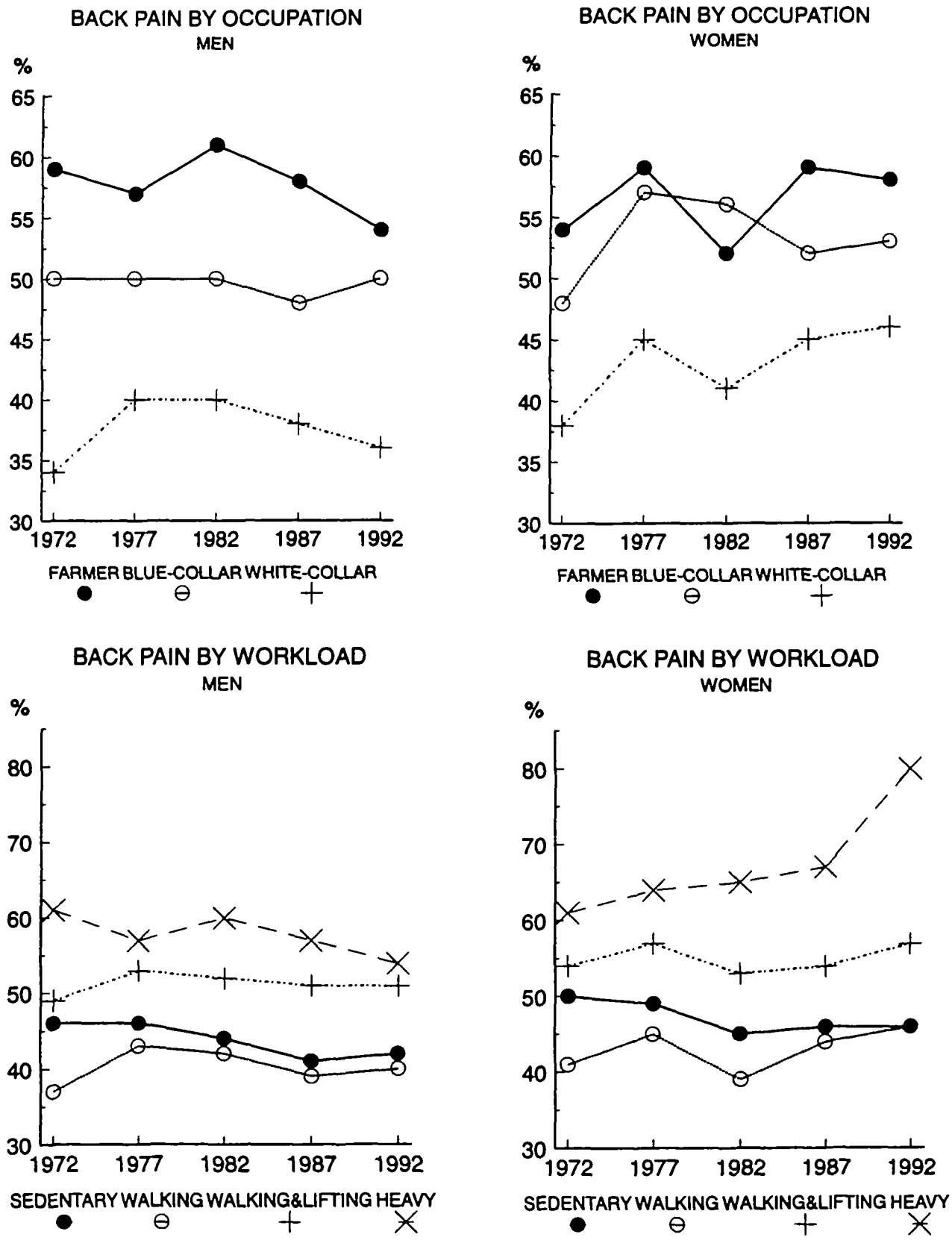

FIGURE 4. Age-adjusted prevalence rates of back pain during the preceding month among men and women in eastern Finland, 1972–1992, by occupation and workload.

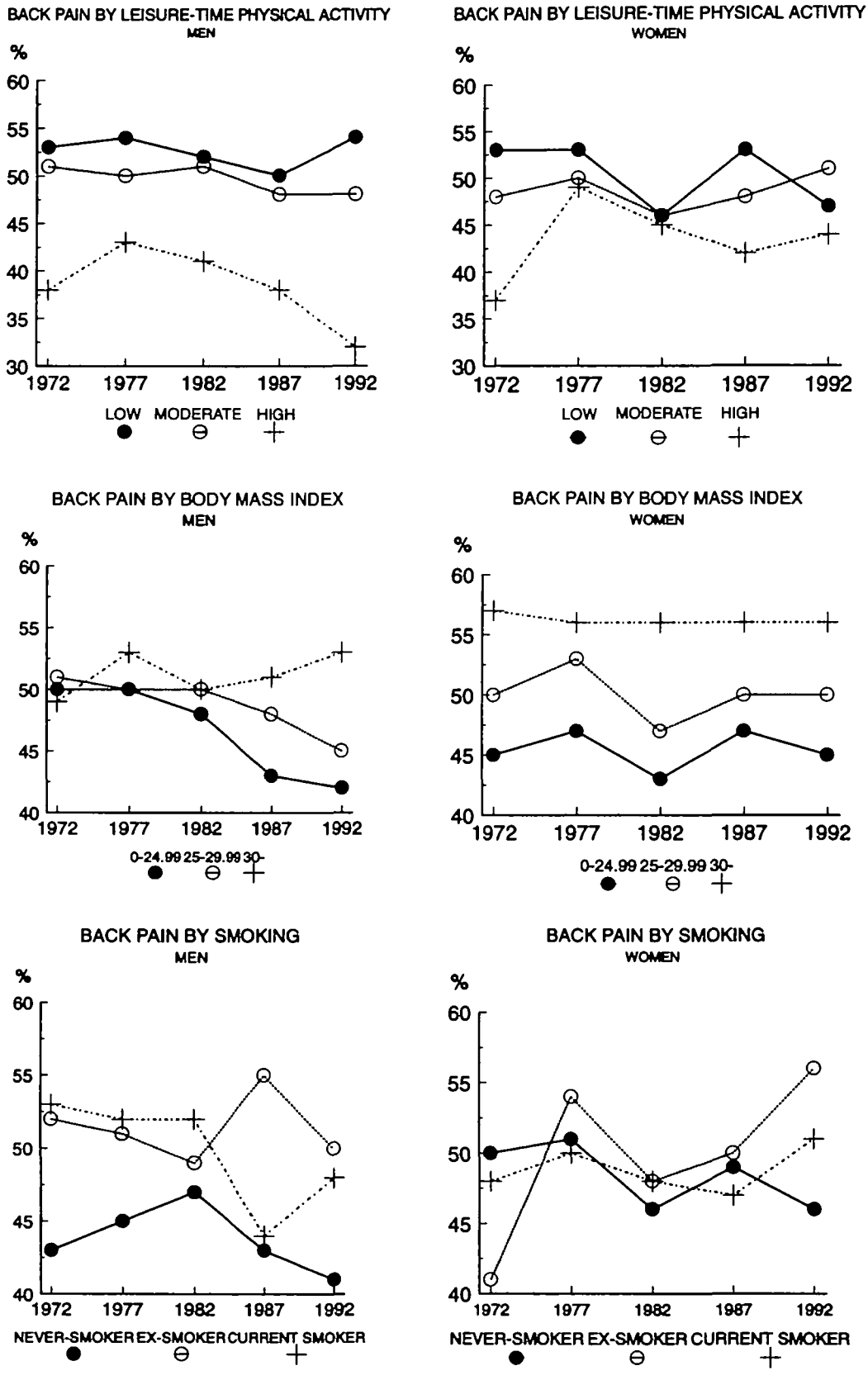

FIGURE 5. Age-adjusted prevalence rates of back pain during the preceding month among men and women in eastern Finland, 1972–1992, by leisure-time physical activity, body mass index, and smoking.

work may have changed during 1972–1992. Concerning women, the category of farmers included housewives on the farms. Their work was probably lighter than other work belonging in this category.

Body mass index was found to be directly proportional to the prevalence of back pain among women. Among men, too, body mass index seemed to be positively associated with the prevalence of back pain at the end of the study period. Positive associations between overweight and back pain have been observed in some previous studies (33, 38), whereas most studies have failed to show such an association (2, 35, 37). The significant interaction of survey year and body mass index we found in relation to the prevalence of back pain among men further supports the view that overweight is not a true risk factor for back pain.

Associations between smoking and back pain have consistently been found in a number of studies (6, 32, 35, 38, 43). The results of this study are in line with the previous observations. In women, however, the association between smoking and back pain became apparent only toward the end of the study period, but even then, female ex-smokers had the highest prevalence rates. In the early surveys, however, the female ex-smoker category was rather small, which may explain the sudden changes in this category.

In conclusion, there was a slightly decreasing trend in the prevalence of back pain. The prevalence rates seemed to differ considerably between subgroups of the population. However, the trends varied markedly between the categories according to household income and also according to some suspected risk factors for back pain, such as overweight and leisure-time physical activity. Thus, future trends in the prevalence of back pain are difficult to predict.

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