

Prevalence of back pain among fulltime United States workers

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ABSTRACT A source of data on the health and working conditions of a probability sample of United States workers, the Quality of Employment Survey for 1972-3 (QES73), is investigated for the first time to determine which groups of workers are more or are less likely to report back pain. Estimated coefficients from a logistic regression are used to calculate odds ratios and confidence intervals for various groups. Few previous studies on back pain among United States workers control for as many potentially confounding variables as are considered in this study and few use data from a national probability sample of workers. The following independent variables are judged to be important positive correlates based on their estimated odds ratios and confidence intervals: farm, service, blue collar, and clerical work; low levels of schooling and income; jobs needing physical effort; age between and including 50 to 64; and smoking. Marital separation was found to be negatively correlated with back pain. Caution should be exercised in attempting to generalise these findings, since the back pain variable is based on respondents' subjective evaluations. Moreover, the variable does not distinguish between lower or upper back or neck pain, nor is information on the duration or frequency of pain available.

Back pain represents a significant problem for workers and employers¹⁻¹³ and back injuries produce approximately 19-25.5% of all workers' compensation claims.^{5,10} In addition to the severity of the problem, the burden of suffering from back pain is not equally shared by all workers. The greatest frequency for back pain among workers has been reported to occur between the ages of 35 and 55.⁴ No consensus has emerged concerning the relative risks faced by men versus women or blacks versus whites, yet workers' compensation claims for back pain are more often filed by men than women.⁹ Workers found to be at greater risk for back pain include those who are tall, obese, divorced, separated or widowed, and who completed only a few years of schooling.⁴ Activities reported to be associated with increased risk of back pain include overexertion in association with lifting, bending, or pulling^{4,5,10}; prolonged static work position⁴; and heavy physical labour.³ Readers seeking a comprehensive review of the epidemiology of back pain are referred to Kelsey.¹³

A recent review of back pain among employees by

Anderson listed 136 studies, most of which were based on data from countries other than the United States.⁴ Whereas many epidemiological studies of back pain have relied on United States data, the data have typically been for the adult population at large, not just for working individuals. Moreover, a search did not find any United States study on workers which used a multivariate statistical design.

The present study contains results from a national sample of workers, widely used by economists and sociologists but not by epidemiologists. This study assesses the magnitude and distribution of self reported prevalence of back pain among selected occupational groups. The following independent variables are considered as possible correlates of back pain: age, race, gender, income, schooling, marital status, height, weight, smoking status, occupation involving heavy labour or repetition or both, and broad occupational groups.

Materials and methods

A national survey of the quality of employment (QES) was conducted in January and February 1973 by the

high probability of a type 1 error if the patient's life is at stake.

Gardner and Altman argue that both the estimated size and precision of the odds ratio should matter. They point out that information about the precision of an estimate as measured by the standard errors is most usefully presented in a confidence interval rather than a p value. A confidence interval focuses attention on the estimated size of the odds ratio and the most reasonable range of estimates that should surround the true population odds ratio. They do not suggest any particular rule to assess the importance of an independent variable but note, however, that intervals with more values above than below 1 are more desirable than intervals with more values below 1 for variables assumed to be positively associated with the dependent variable. They also recognise that p values are not entirely useless since the smaller the p value, the less likely the interval will contain values below 1.

But a complete reliance on confidence intervals and odds ratios ignores the important question raised in a hypothesis test: Do the data suggest that the true population odds ratio is greater than one? Could the observed sample estimate of an odds ratio be greater than 1 simply as a matter of chance?

There does not yet appear to be a consensus among epidemiologists concerning which is the most appropriate criteria—p values, odds ratios, or confidence intervals. The methodological strategy used here, consequently, is to present information on all three and rely on our judgement to assess the most important correlates.

Stepwise regression is not relied on to determine whether an independent variable is important since stepwise regression, whether forward or backward, suffers two serious drawbacks identified by Cassidy,²¹ and Leigh²²: (1) the signs of the estimated coefficients at intermediate or final stages of the stepwise routine may be incorrect and (2) stepwise procedures may result in the exclusion of a relevant variable that was excluded just because of the arbitrary order in which the selection takes place (according to the contribution to the R² or the chi-square). Nevertheless, in results available from the authors, a forward stepwise procedure was run on the data and the results concerning the important correlates were not altered.

Results

UNIVARIATE ANALYSES

Table 1 presents descriptive statistics and calculated chi-squares on selected variables, most of which were statistically significant, extracted from the QES. A larger version of table 1, available from the authors, indicates all variables whether or not they were statistically significant. The list of possible correlates

Table 1 Descriptive statistics and calculated chi-squares on selected variables

	Total	No		df	Chi squares
		Total (%)	Back pain (%)		
Sex:					
Male	959	67.8	186	19.4	1 0.24
Female	455	32.2	94	20.7	
Race:					
White	1262	89.3	245	19.4	1 2.15
Black/other	152	10.7	37	24.2	
Occupation:					
Professional	223	15.8	27	11.9	9 34.16*
Farmer/farm labourers	42	3.0	15	34.9	
Manager	217	15.4	36	16.7	
Clerical	208	14.7	30	14.7	
Sales	70	4.9	11	15.5	
Craftsman	211	14.9	45	21.4	
Operative	241	17.0	64	26.4	
Private household	11	0.8	3	27.3	
Service	138	9.8	37	27.0	
Non-farm labourers	53	3.7	12	23.1	
Education:					
≤ 8 grades	169	12.0	52	30.6	3 21.77*
9-11 grades	192	13.6	45	23.5	
12 grades	538	38.0	104	19.3	
≥ 13 grades (trade school)	515	36.4	79	15.4	
Personal:					
Current smoker = 1	706	49.9	159	22.5	1 6.36*
Non-smoker = 0	708	50.1	121	17.1	
Conditions on job:					
Does require much physical effort = 1	371	26.2	101	27.2	1 20.00*
Does not = 0	1043	73.8	179	17.2	
Does require much repetitious work = 1	745	52.7	165	22.2	1 5.14*
Does not = 0	669	47.3	115	17.2	

*p < 0.05.

Results on marital status, age, income to respondent, obesity, and being tall are available from the authors.

closely follows the list in Reisbord and Greenland¹⁸ except that the table 1 list includes more than that of Reisbord and Greenland. The additional variables include measures of height (tall), weight (obese), information on the smoking habit (smoker), and information on repetitive nature of the job.

Table 1 shows some interesting patterns. Fewer than 1% more women than men report back pain in the QES sample, whereas 24.3% of non-whites, but only 19.4% of whites, report back pain. In part, the race disparity could be due to the disproportionate number of non-whites in production jobs and low schooling categories. Subjects who never married have the highest prevalence of back pain, whereas widowers (male and female) report the lowest in the marital status category. Although these results would not be

expected in a sample including non-working and retired subjects, it could be that a self selection phenomena is at work. Widows who elect to work may be a particularly healthy group since many widows with children would receive social security benefits if their husbands had been working before death, as would be the case for most women in 1973.

Age categories provide clues for the prevalence of back pain. Whereas only a narrow (0.9) difference exists between the mean per cents for 18–34 years and 35–49 years, workers in the 50–64 years category suffer the most and in the 65 years and over category suffer the least. The patterns for the 50 and over groups are easily explained. The 50–64 category is the oldest category of workers in the preretirement years. Most of these workers, younger than 62, cannot retire with social security (unless they are disabled), and hence must work. They suffer a disproportionate amount of back pain because of their age. The 65 and over group are unique. Most, if not all, could retire with social security, but do not choose to. A strong healthy worker effect keeps their prevalence low. The age variable does not achieve statistical significance at the 0.05 level, perhaps due to the relatively few workers (33) in the 65 and over group.

There appears to be a negative association between income and back pain in the univariate results. The greatest per cent occurs in the \$5000 or less group and the least in the over \$20 000 group. In part, this result could reflect reverse causality. People with back pain may earn less because of their pain. Alternatively, it may be that the incomes reflect the jobs so that low income indirectly measures production work and high income, professional work. A multivariate design is, therefore, required to consider further the association between income and back pain.

QES respondents were asked to evaluate their own weight by stating whether they were obese, overweight, right weight for height, thin, or skinny. Roughly 1.7% stated that they were obese. A respondent's actual weight, although preferred, was not recorded by QES interviewers. Because the obese variable relies on subjective evaluations, it is open to various criticisms so that results on the obese variable should be viewed with caution. It is used simply because it is the only measure of weight in the QES. For the 1.7%, obese = 1 and for the 98.3% obese = 0. Only a slight 1% difference in the prevalence of back pain was observed between the obese and the not obese groups.

The tall variable equalled 1 for men who stated that they were taller than 72 inches and 1 for women taller than 68 inches. Roughly 23% of tall people so classified reported back pain whereas 19.5% of "not tall" people reported back pain.

Whereas the descriptive results for the variables of

sex through to obese and tall are suggestive they must nevertheless be critically viewed. None of the differences in variables mentioned, sex through to obese and tall, were statistically significant at the 0.05 level. Variables that did achieve statistical significance include occupation categories, education, smoking status, and conditions on the job.

It appears that white collar workers (professionals, managers, sales workers, and clerks) suffer less and blue collar workers (craftsmen, operatives, and labourers) and service workers more back pain. A pronounced education effect is also apparent. The fewer the years of schooling, the greater the chance of back pain complaints and the more the years of schooling, the less the chance of complaints. The smoker variable measured current smoking status. Smokers equalled 1 for people stating that they currently smoke and 0 otherwise. No QES information was available on quantity smoked. Being a smoker, however, may put workers at increased risk of back trouble.

The univariate results also suggest that both job conditions are associated with increased frequency of back pain. Employees in jobs requiring "lots of physical effort" and "lots of" repetitious work reported more back pain than employees not holding jobs requiring physical effort and repetitious work.

As with all univariate analyses, the search for simple associations is limited. Multivariate analyses are required so that the effects of confounding are minimised.

LOGISTIC REGRESSION

Table 2 presents the results on estimated odds ratios and 95% confidence intervals derived from estimated coefficients and standard errors produced by a logistic regression explaining the log-of-the-odds of back pain. In the interest of brevity table 2 presents only results on selected variables. Results on all the variables are available from the authors.

The chi-squared statistic from the logistic regression, 188, is greater than the critical chi-square indicating that at least one of the explanatory variables is making a statistically significant contribution toward explaining prevalence of back pain.

Several interesting patterns emerge among the occupational categories, age, years of schooling, and annual wages. Estimated odds ratios are smallest for occupations most similar to professionals and managers and largest for occupations least similar to professionals and managers. The estimated odds ratios for clerical and sales workers are only 1.38 whereas ratios for service workers are 2.67; craftsmen, operatives, and labourers 2.39; and farmers and farm workers 5.17.

The age pattern appears to be an upside-down "U."

Table 2 Logistic regression results explaining the probability of reporting back pain

Explanatory variables	Estimated coefficient (asymptotic standard error)	Odds ratios (95% confidence intervals)
Intercept	-4.154 (0.5333)	
Female compared with male	0.1915 (0.2521)	1.21 (0.74- 1.98)
Non-white compared with white	0.1895 (0.3273)	1.21 (0.64- 2.28)
Clerical or sales worker compared with professionals and managers	0.3288 (0.2500)	1.38 (0.85- 2.25)
Craftsman or operative or labourer compared with professionals and managers	0.8717* (0.4017)	2.39 (1.09- 5.25)
Service workers compared with professionals and managers	0.9832* (0.3854)	2.67 (1.26- 5.69)
Farmer or farm labourer compared with professionals and managers	1.6435* (0.6072)	5.17 (1.57- 17.01)
Omitted category is professionals and managers		
Schooling:		
8 grades or fewer compared with 13 grades or more	0.7803* (0.3797)	2.18 (1.04- 4.63)
9-11 grades compared with 13 grades or more	0.3707 (0.3384)	1.45 (0.75- 2.81)
12 grades compared with 13 grades or more	0.0534 (0.2494)	1.05 (0.65- 1.72)
Omitted schooling category: 13 grades or more		
Tall = 1 if male height is 72" or female height 68" compared with not tall	0.4973 (0.3385)	1.64 (0.84- 3.19)
Current smoker compared with non-smoker	0.3910* (0.2008)	1.48 (1.00- 2.19)
Physical effort = 1 if respondent states job requires much physical effort compared with does not require	0.5217* (0.2404)	1.68 (1.05- 2.90)
Repetitious work = 1 if respondent states job requires much repetitious work compared with does not require	0.1806 (0.2116)	1.20 (0.79- 1.81)
Sample size	1414	
- 2 (log of likelihood)	188.4619	
Critical chi-square for 25 df	37.6525	

*Significant at the 0.05 level in a two tailed test.

Results on marital status, age, income to respondent, obesity, are available from the authors.

The ratios range from 1.00 for 35-49 to 1.59 for 50-64 and fall to 0.96 for 65 and over.

Back pain appears to be inversely related to years of schooling. The eight grades or fewer odds ratio is 2.18, whereas 9-11 grades drop to 1.45 and 12 grades to 1.05.

The annual wage pattern is not as clear as the others. The ratios rise from 1.41 for \$5000 or less to 2.04 for \$5001-\$10 000 but fall to 1.90 for the \$10 001-\$20 000 category.

To assess the most versus least important correlates of back pain, the variables with the highest odds ratio and largest lower confidence interval were selected for further scrutiny.

To assess the importance of each possible correlate, the variables were placed into two groups depending on their estimated odds ratio and the size of their lower confidence limit. Variables with large odds ratios and large lower limits were judged more likely to be important and those with small odds ratios and small lower limits were judged to be less likely important correlates of back pain. The size of the odds ratios matters, as Gardner and Altman suggest.²⁰ The size of the lower limit matters because the larger the lower limit, the greater the p value.

The variables thus classified as unlikely to have an association with back pain and their corresponding lower confidence limits (in parentheses) are the following: sex (0.74), race (0.64), divorced (0.30), widowed (0.54), never married (0.20), age 35-49 (0.62), age 65 and over (0.24), 12 years of schooling (0.65), \$5000

or less in annual wages (0.47), obese (0.21), and repetitious work (0.79).

The variables more likely to be associated with back pain include those with lower confidence limits either a little below or greater than one. The potentially important variables may be ranked according to their estimated odds ratios as follows (lower confidence limits in parentheses): (1) farmer and farm labourers (1.57); (2) service workers (1.26); (3) craftsmen, operatives, or labourers (1.09); (4) eight or fewer years of schooling (1.09); (5) \$5000-\$10 000 annual wages (0.72); (6) \$10 001-\$20 000 annual wages (0.70); (7) job needing much physical effort (1.05); (8) men taller than 72 inches and women than 68 inches (0.85); (9) aged 50-64 (0.92); (10) smokers (1.00); (11) 9-11 years of schooling (0.75); (12) clerical or sales workers (0.85).

The separated marital status category is also included in the potentially important group but its estimated coefficient is negative, hence its lower confidence limit and odds ratio cannot be compared with the other variables.

Discussion

In agreement with the results of Reisbord and Greenland's multivariate study¹⁸ we do not find a likely effect for sex or race since neither variable is in the "more likely" group. This is in contrast with the univariate analyses in Nagi *et al* in which sex and race were important correlates.¹⁷ It is tempting to conclude that

in univariate analyses sex and race variables were actually serving as proxies for employment status or schooling.

Again, as do Reisbord and Greenland and Nagi *et al*, we find weak multivariate and univariate associations between marital status and back pain.^{18,19} Estimated odds ratios and prevalence proportions are less for divorced and separated individuals when compared with single people, widows, and widowers.

The importance of occupation is strongly confirmed by the results in table 2. When compared with professionals and managers (1) craftsmen, operatives, and labourers, (2) service workers, (3) clerks and sales people, and especially (4) farmers and farm workers have significantly higher prevalence odds of back pain. The results for the disparity between blue and white collar work are consistent with those reported by Frymoyer *et al*²³ and Andersson.⁴ Moreover, with the exception of the clerks and salespeople category, every other occupation category has a lower 95% confidence limit for the odds ratio greater than one.

The results for the occupation categories may reflect a causal relation. Blue collar work requires lifting, bending, pulling, and heavy physical labour, all of which have been identified as risk factors for back pain.^{3-5,10} White collar work may put less physical strain on the back.

The results for age and schooling are consistent with those in Reisbord and Greenland.¹⁸ People in the preretirement years, 50-64, suffer more back pain, other things being equal, than those aged 18 to 34. Whereas most studies find that advancing years beyond 65 is associated with back pain, no association is found here. A simple healthy worker argument will explain this anomaly, however. People in the QES sample over 65 are full time employees. Most people older than 65 are retired. Individuals who choose to work beyond 65 are probably healthy and unlikely to suffer back pain.

The results for schooling are consistent with those published concerning the association between schooling and overall health. Grossman²⁴ and Leigh,²⁵ for example, find strong statistical associations between schooling and subjective measures of general health in two data sets drawn from national probability samples. Increased educational attainment was found to be associated with better health. The results in table 2 indicate a similar finding. Since the omitted category is 13 or more years of schooling, positive coefficients on the three schooling variables indicate that fewer than 13 years of schooling is associated with greater prevalence of back pain. Moreover, the size of the odds ratios drop from 2.18 for eight grades or fewer to 1.07 for 12 grades, again consistent with a positive relation between schooling and overall health. Whereas only the first schooling variable, eight grades

or fewer, is statistically significant at better than the 0.05 level in a one tailed test, the lower confidence intervals for 9-11 grades and 12 grades are 0.75 and 0.65, not far below 1.

The QES data do not suggest any statistically significant correlation at the 0.05 level between wages and odds prevalence of back pain, again consistent with Reisbord and Greenland.¹⁸ But two categories of wages, \$5001-\$10 000 and \$10 000-\$20 000 were in the "more likely" group of possible correlates. The results suggest that people with the greatest earnings, \$20 000 or more (in 1973), experienced less back pain than those in all other income categories. In part, this could reflect reverse causality. People who suffer severe pain may not be able to work as many hours as those who suffer no pain.

The lack of a statistically significant effect for the obese variable is, at first sight, surprising, since many prior studies implicate obesity as a risk factor for back pain.⁴ But the lack of any finding present in the QES may result from the variable's construction. The obese variable is constructed from the subjective evaluation of the respondent's weight by the respondent. Individual variation in what respondents regarded as obese resulted in a small sample size problem. Only 12 respondents in the sample of 1414 reported themselves to be obese.

The apparent lack of height as a statistically significant variable at the 0.05 level was also unexpected. But closer examination shows that the asymptotic statistic for height, 1.469, is statistically significant at the 0.10 level in a one tailed test (critical p is 1.28). The 0.10 level is viewed as statistically significant in the results for the height variable are consistent with those reported in Andersson's review of studies on back pain among workers.⁴

Smokers apparently report more back pain than non-smokers as the statistically significant coefficient ($p \leq 0.05$) on smoker = 1 shows in table 2. The results are consistent with those found in Frymoyer *et al*.^{23,26}

It is not clear what the causal mechanism might be linking smoking with back pain. A misplaced cigarette might require additional reaching and stooping that would otherwise occur. The correlation may also result from some unobserved third variable reflecting a desire to practise healthy habits. People who smoke may be more reckless with their health than non-smokers. Smokers may be more inclined than non-smokers to lift things with their backs rather than their legs, for example.

The interpretation of the results for jobs needing physical effort and involving repetitious work requires an understanding of the variable construction. If the respondent stated "lots of" physical effort demanded he or she received a 1 for the physical effort variable. The repetitious job variable was similarly constructed

Thus we expected a positive coefficient on both variables since physical effort and repetitious jobs have been found to be associated with prevalence of back pain for workers.⁴ Our results do not support any strong statistical association ($p \leq 0.05$) between repetitious work and prevalence odds of back pain. Nevertheless, the estimated odds ratio is greater than 1 and the lower confidence interval is 0.75. Strong statistical evidence is provided, however, for a physical effort and back pain association. The physical effort variable is significant at the 0.05 level in a two tailed test and has the expected positive sign. Moreover, the estimated odds ratio is reasonably large—1.68.

We would like to express our appreciation to Lorann Stallones, Sander Greenland, and Lesley Reisbord for helpful suggestions. This project was supported by grant number RO1 OH02586 from the National Institute for Occupational Safety and Health.

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