REVIEW

Formal education and back pain: a review

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Abstract

Objectives—To summarise the scientific evidence on the relation between educational status and measures of the frequency and the consequences of back pain and of the outcomes of interventions among back pain patients, and to outline possible mechanisms that could explain such an association if found.

Design—Sixty four articles published between 1966 and 2000 that documented the association of formal education with back pain were reviewed.

Main results—Overall, the current available evidence points indirectly to a stronger association of low education with longer duration and/or higher recurrence of back pain than to an association with onset. The many reports of an association of low education with adverse consequences of back pain also suggest that the course of a back pain episode is less favourable among persons with low educational attainment. Mechanisms that could explain these associations include variations in behavioural and environmental risk factors by educational status, differences in occupational factors, compromised “health stock” among people with low education, differences in access to and utilisation of health services, and adaptation to stress. Although lower education was not associated with the outcomes of interventions in major studies, it is difficult, in light of the current limited available evidence, to draw firm conclusions on this association.

Conclusion—Scientific evidence supports the hypothesis that less well educated people are more likely to be affected by disabling back pain. Further study of this association may help advance our understanding of back pain as well as understanding of the relation between socioeconomic status and disease as a general phenomenon.

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Low socioeconomic status (SES) is associated with increased mortality and morbidity from many conditions, including musculoskeletal disorders.¹⁻³¹ Examination of this association has improved our understanding of the causes and natural history of some diseases, among

which are breast and cervical cancers^{32 33} and myocardial infarction.^{34 35}

Education is often considered the best surrogate measure of SES, because it is generally easy to collect and is unlikely to be affected by chronic diseases that begin in adult life, as might occupation and income.³⁶ It provides us with a quick and useful proxy for a much more complex set of social factors.^{1 6 7 11 12 14 37} Education may also be a marker for specific traits like intelligence, acquisition of adaptive skills, or awareness of risky health behaviours.

Back pain affects 70% to 80% of adults at some time during their lives,³⁸ and represents an enormous burden for industrial societies.³⁹⁻⁴⁵ Back problems constitute one of the most common reasons for all physician visits in the United States,^{46 47} and a leading cause of disability among adults.^{39 48} Although our knowledge of the causes and the natural history of back pain has benefited from extensive research efforts, it is still rather limited.^{42 48 49} Assuming that research on back pain might benefit from the investigation of the relation between back problems and SES, we reviewed the scientific evidence linking formal education to back pain, and possible mechanisms that may explain this association.

Education has been considered to play three different parts in relation to back pain: as a predictor of the frequency (incidence, recurrence and prevalence) of back pain, as a predictor of the outcomes of back pain episodes (importance and duration of pain and disability, interference with work and other activities, and health care consumption), and as a predictor of the outcomes of surgical and rehabilitative interventions performed among series of back pain patients.

Methods**SELECTION OF ARTICLES**

Articles documenting the association of formal education with back pain that were published between January 1966 and June 2000, were identified through a search on the 1988-2000 Embase, 1966-1999 ERIC and 1966-2000 Medline databases, and reviewed. The search strategy included “back pain or backache” and “educational status or formal education”. Because formal education is often not mentioned in articles’ titles, key words or abstracts, several papers were identified through a broader search of epidemiological studies on

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back pain, especially those that have investigated psychosocial and socioeconomic factors.

QUALITY ISSUES

Each article was rated according to the following quality criteria with regards to the assessment of the formal education-back pain association: (1) selection of participants, (2) sample size (≥ 300), (3) measure of education, (4) length of follow up (≥ 3 months), (5) drop out rate ($< 40\%$), (6) measure of outcome, (7) multivariate analysis, (8) point estimates and (9) consideration of effect modification by gender. The last four criteria were assessed for each outcome measured in a study. Criteria were broadly applied, and designated "acceptable" or "not acceptable". When the information was insufficient to make a clear judgement, the criteria were designated "not acceptable". Studies with less than four "not acceptable" scores were labelled "major study" and used for interpretation. Studies with four or more "not acceptable" scores were labelled "other study".

Results

EDUCATION AND THE INCIDENCE, RECURRENCE AND PREVALENCE OF BACK PAIN

Table 1 summarises 19 major studies that have examined the association between education and measures of back pain frequency in 23 instances. In 19 instances reported in 16 studies, low educational status was significantly associated with increased prevalence of back pain.^{4 11 18 29 36 50-60}

Only four major studies found no significant association of formal education with the frequency of back pain.^{58 61-63}

There was no apparent pattern of similarity among the negative studies by design, country nor outcome measure. However, three of the four negative studies had sample sizes among the four smallest of all major studies ($n=238$ to 481 compared with 1135 to $84\,572$).⁶¹⁻⁶³ The other negative report was that of Hurwitz and Morgenstern (1997), who, with the largest sample size of all major studies ($n=84\,572$), found a significant association between low education and two week period prevalence of disabling back pain but no association with the two week prevalence of non-disabling back pain (no back related restricted activity days).⁵⁸ Only one study with a small sample size ($n=154$) found an association between low education and a higher frequency of back pain, but it was significant only among women.¹⁸

These observations have two implications: (1) given that the association of education with back pain frequency is often observed in large population surveys, one might argue that it is an artefact created by the very high statistical power of these studies. Although this could be true in some instances, this position is challenged by the fact that one small study found the association to be significant and that a quite large survey did not; (2) there seems to be some important differences according to the outcome measures used, although back pain is defined so heterogeneously across studies that it is very difficult to draw consistent lines. As there might be very important differences

between various forms of back pain beyond the strict duration of symptoms,⁶⁴ it is possible that education is associated only with the most severe forms of back pain, but that revealing this relation requires higher statistical power. Thus, it seems possible that heterogeneity in results across studies comes in part from a combination of differences in outcome measures (more or less stringent definitions) and variation in statistical power.

In the only major incidence study, a report on 271 subjects without any prior history of back pain from a probability sample of a large Washington State HMO's enrollees, the odds ratios comparing back pain incidence among subjects with some college and college graduates and subjects with high school or less were 0.59 and 1.01 respectively, both statistically non-significant.⁶¹

In positive major studies, although the strength of the association or the differences are sometimes relatively small, the point estimates are generally adjusted for several variables that often include other measures of SES like occupation and income and other variables that could be intermediate between education and outcomes. Such overadjustment would usually bias results toward the null (that is, toward finding no association),⁷² as would also do random misclassification of education, as it has been demonstrated that most people tend to exaggerate the amount of schooling they have obtained.⁷³ The association between low education and the frequency of back pain observed in most major studies thus seems to be quite robust.

The majority of studies reviewed were cross sectional and examined self reported point, period or lifetime prevalence of back pain. As amount of formal schooling rarely changes after age 20-25 and disabling back pain typically begins after that age, there is probably no important problems with regard to temporal sequence in making cross sectional comparisons. Relying on self reported prevalence of back pain leads to two main concerns: firstly, the association of education with back pain frequency is potentially confounded with differences in recall and reporting of back symptoms across education groups. Prior research using physician validated outcomes suggests this is not an important source of bias. For instance, in the study of Cunningham and Kelsey (1984) low education was found to be associated with higher point prevalence of signs and symptoms of back pain, in agreement with most other prevalence studies that used self report of back pain.⁴ Secondly, as for chronic episodic diseases prevalence is approximately (incidence) $\times$ (average episode duration) $\times$ (average number of episodes),⁷⁴ the association of formal education with back pain prevalence could reflect an effect of education on back pain onset rates, duration, or number of back pain episodes or some combination of them. Using period prevalence of back pain constitutes a particular problem, because this measure fails to distinguish between incident and prevalent cases. No major studies have looked specifically at the

Table 1 Summary of studies on education and the frequency of back pain

First author, year, country and reference	Type of study	Subjects (n)/(response rate)	Definition of education*	Measure of outcome	Association†	Point estimates	Major weaknesses‡
Major studies							
Lutza (2000) Germany ⁶⁰	Cross sectional	Population based sample of adults aged 25–74 years in Lübeck, Germany, in 1991–1992 (Lübeck Survey on Back Pain) - (n=2731) / (80.9%)	(1) Low (8–9 years)§ (2) Intermediate (10–12 years) (3) High (≥13 years)	→Point prevalence of severe back pain (self report)	Inverse	OR (95% CI) (2) 0.24 (0.09, 0.67) (3) 0.35 (0.21, 0.58)	L
Barnekow-Bergkvist (1998) Sweden ⁶¹	Cross sectional	Sample representative of 16 year old boys and girls in the first year of upper secondary school in Sweden, assessed 18 years later (n=238) / (65%)	(1) <14 years§ (2) ≥14 years	→Period prevalence of disabling low back pain (self report—at least once per month—preceding 12 months)	No	OR (95% CI) (2) 1.53 (0.28, 8.48) (2) — — —	S Z L
Heistaro (1998) Finland ⁶⁰	Cross sectional	Independent random samples of 30–59 year old, drawn from the population register of the eastern provinces of North Karelia and Kuopio, Finland, every five years from 1972 to 1992 (North Karelia Project) - (n=29 043) / (69–96%)	Years of schooling tertiles: (1) Low and middle§ (2) High	→Period prevalence of back pain (self report - preceding month)	Inverse	OR (95% CI) (2) 0.77 (0.73, 0.81)	S L
Leino-Arias (1998) Finland ²⁹	Cross sectional	Random sample of the occupationally active Finnish population aged 20–64 years, in 1988–1990 (n=7544) / (73–82%)	(3) Basic (≤9 years) (2) Secondary (10–12 years) (1) Higher (>12 years)§	→Period prevalence of back pain (self report - preceding month)	Inverse (only among men)	OR (95% CI) (2) 1.38 (1.14, 1.68) (3) 1.80 (1.47, 2.19) (2) 1.12 (0.94, 1.34) (3) 1.05 (0.87, 1.27) (2) 1.47 (1.11, 1.94) (3) 1.91 (1.46, 2.51) (2) 1.36 (1.03, 1.80) (3) 1.60 (1.21, 2.11)	L
Hurwitz (1997) United States ⁵⁸	Cross sectional	Multiple random sample of the civilian non-institutionalised population of the US aged 18 years and over (1989 National Health Interview Survey) - (n=84 572) / (94.9%)	(1) < High school graduate§ (2) High school graduate > (3) High school graduate	→Period prevalence of disabling back pain (self report - preceding 2 weeks) →Period prevalence of non-disabling back pain (self report - preceding 2 weeks)	Inverse No	OR (95% CI) (2) 0.92 (0.87, 0.98) (3) 0.84 (0.78, 0.90) (2) 0.98 (0.91, 1.06) (3) 1.02 (0.94, 1.11)	L G L G
Strooks (1997) The Netherlands ²⁹	Cross sectional	Cohort of 25–64 year old non-institutionalised people with Dutch nationality in a South East region of the Netherlands (LS-SEHD) - (n=13 391) / (70.1%)	(4) Primary school (3) Lower general and vocational education (2) Intermediate vocational and intermediate/higher general education (1) Higher vocational college and university§	→Point prevalence of 23 chronic conditions, including low back pain (self report)	Inverse (only among men)	OR (95% CI) (2) 1.34 (1.15, 1.56) (3) 1.28 (1.12, 1.47) (4) 1.49 (1.26, 1.77)	L O
Harreby (1996) Denmark ⁶²	Longitudinal (25 years)	All 14 year old pupils in Helsingør, Denmark, in 1965 (n=481) / (83%)	Not stated	→Period prevalence of severe low back pain (pain lasting for more than 30 days - self report - preceding 12 months)	No	(2) 1.00 (0.83, 1.21) (3) 0.97 (0.82, 1.14) (4) 1.12 (0.92, 1.36)	E P
Litira (1996) Canada ²⁷	Cross sectional	Household-based population survey of all residents aged 16 to 64 years living outside institutions and Indian reserves in Ontario, Canada (Ontario Health Survey) - (n=18 920) / (77.5–87.5%)	(1) Primary or some secondary (2) Completed secondary or some post-secondary (3) Completed post-secondary	→Point prevalence of long term disabling back problems (self report)	Inverse	Prevalence of outcome (95% CI) (1) 10.5% (9.3, 11.7) (2) 7.3% (6.3, 8.2) (3) 5.7% (4.7, 6.7)	L M G
Croft (1994) United Kingdom ⁶⁶	Cross sectional	Large sample of the British adult population aged 18 and more, living in private households (Health and Lifestyle Survey) - (n=90003) / (73.5%)	(5) None (4) General certificate of education-Ordinary (O level) (3) Certificate of education-Secondary (A level)	→Period prevalence of back pain (self report - preceding month)	Inverse (only among women)	OR (95% CI) (2) 0.77 (0.31, 1.87) (3) 1.18 (0.84, 1.65) (4) 0.95 (0.68, 1.31) (5) 1.19 (0.89, 1.59)	L

Table 1 Continued

First author, year, country and reference	Type of study	Subjects (n)/(response rate)	Definition of education*	Measure of outcome	Association†	Point estimates	Major weaknesses‡
Park (1993) United States ⁵⁵	Cross sectional	Household survey designed to provide estimates representative of the US civilian aged 18 and over (1988 National Health Interview Survey) - (n=27 408) / (87%)	(2) Professional qualification (1) University degree§	→Period prevalence of back pain every day for a week or more (self report - preceding 12 months)	Inverse	Women (2) 0.83 (0.52, 1.30) (3) 0.97 (0.62, 1.53) (4) 1.26 (0.89, 1.81) (5) 1.45 (1.02, 2.05) Prevalence of outcome (1) 21.3% (2) 20.1% (3) 19.1% (4) 15.8% OR (statistical significance) (2) 0.59 (NS) (3) 1.01 (NS) OR (95% CI) (2) — — — (3) — — — Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	LM G
Von Korf (1993) United States ⁶¹	Longitudinal (3 years)	Persons with no prior history of back pain at baseline among a probability sample of adult enrollees of a large HMO (n=271) / (85%)	(1) High school or less§ (2) Some college (3) College graduate (4) Elementary or less	→Incidence of back pain (self report)	No	OR (statistical significance) (2) 0.59 (NS) (3) 1.01 (NS) OR (95% CI) (2) — — — (3) — — — Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	Z G
Vilkkari-Juntura (1991) Finland ¹⁸	Longitudinal (22 years)	Selected respondents of the 1985 follow up of children who lived in the Helsinki Metropolitan region (Healthy Child Study) - (n=154) / (90%)	(1) High school (2) Intermediate secondary (3) High school§	→Period prevalence of severe low back symptoms (self report - preceding 12 months)	Inverse (only among women)	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	S Z
Leigh (1989) United States ⁵⁴	Cross sectional	Probability sample of US workers at least 16 years old working more than 20 h/week (Quality of Employment Survey) - (n=1414) / (weighted)	(4) ≤8 years (2) 9–11 years (3) 12 years (1) ≥13 years§	→Period prevalence of spinal pain (self report - preceding 12 months)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L G
Deyo (1987) United States ⁵²	Cross sectional	Probability sample representing the civilian, non-institutionalised US population aged 25 and over (NHANES II) - (n=10 404) / (weighted)	(1) Elementary or none (2) High school (3) College	→Lifetime prevalence of low back pain for ≥2 weeks (self report)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	LM G
Pincus (1987) United States ¹¹	Cross sectional	Individuals selected from the 1976 cohort of the Health Interview Survey to be representative of the US working age population (18–64 years) - (n=5652) / (weighted)	(4) ≤8 years (3) 9–11 years (2) 12 years (1) ≥13 years§	→Point prevalence of back stiffness or deformity (self report - “as told by a physician”) →Point prevalence of other back problems (self report - “as told by a physician”)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L
Saraste (1987) Sweden ⁵³	Cross sectional	Random, geographically stratified 1:1000 sample of the Swedish working population aged 30–59 years (n=2872) / (?)	Pre-high school High school Post-high school	→Lifetime prevalence of low back pain with disability (self report)	Inverse (only among men aged 30–39)	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L R M
Reisbord (1985) United States ⁵¹	Cross sectional	Adult enrollees in a health insurance plan (n=2792) / (weighted)	(1) Less than high school§ (2) High school (3) Over high school	→Period prevalence of frequent back pain (self report - preceding 12 months)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L
Cunningham (1984) United States ⁴	Cross sectional	Multistage, stratified probability sample of persons aged 25–74 in the US (NHANES I Survey) - (n=6913) / (weighted)	(2) High school (3) Over high school (1) ≥12 years§	→Point prevalence of back abnormalities (physician observed) →Period prevalence of back symptoms (self report - preceding 12 months)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L G
Nagi (1973) United States ³⁰	Cross sectional	Probability sample of all persons 18–64 year old residing within a Standard Metropolitan Statistical Area in Columbus, Ohio (n=1135) / (94%)	(1) ≤8 years (2) 9–11 years (3) 12 years (4) ≥13 years	→Point prevalence of persistent back pain (self report)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	L G
Other studies Bergnerudd (1988, 1994) Sweden ^{30, 71}	Longitudinal (45 years)	Residents of Malmö (Sweden) who participated to the Malmö Longitudinal Study in 1938 and volunteered for a health examination in 1983 (n=575) / (69%)	Not stated	→Point prevalence of back pain (examination)	Inverse	Men (2) — — — (3) — — — Women (2) 5.86 (0.28, 121.19) (3) 35.45 (1.56, 804.55) OR (95% CI) (2) 1.05 (0.65, 1.72) (3) 1.45 (0.75, 2.81) (4) 2.18 (1.04, 4.63) Prevalence of outcome (1) 17.3% (2) 14.4% (3) 11.2% OR (95% CI) (2) 1.0 (1.0, 1.1) (3) 1.5 (1.3, 1.6) (4) 2.4 (2.1, 2.6) (2) 1.3 (1.2, 1.3) (3) 1.8 (1.7, 1.9) (4) 2.0 (1.9, 2.2)	S E M P G

Table 1 Continued

First author, year, country and reference	Type of study	Subjects (n)/(response rate)	Definition of education*	Measure of outcome	Association†	Point estimates	Major weaknesses‡
Jacobsson (1992) Sweden ¹⁹	Cross sectional	Persons living in the Malmö area, aged 50–70 years, randomly selected from population records (Malmö Food Health Survey) - (n=502) / (56%)	≤8 years >8 years	→Point prevalence of low back pain (examination or self report)	Inverse	81% v 56% OR (95% CI) (2) 0.97 (0.74, 1.29)	L R M G
Armenian (1989) Lebanon ⁶⁹	Cross sectional	Stratified random sample of 2752 households in Beirut (Population Laboratory Survey) - (n=13 735) / (?)	(2) Low (1) Middle and high§	→Lifetime prevalence of “chronic” back pain (self report)	No		L R O G
Roncarati (1988) United States ⁶⁸	Cross sectional	Subjects in sport medicine, physical therapy clinics, high schools and universities (n=674) / (?)	Unclearly stated	→Point prevalence of traumatic or intrinsic low back pain (differential diagnosis by an orthopaedist)	Direct		S E L R M P G
Biering-Sørensen (1986) Denmark ⁸⁷	Longitudinal (12 months)	Inhabitants of Glostrup (Denmark) 30–60 year old invited to take part in a free general health survey (n=928) / (82%)	Not stated	→One year incidence of low back pain (self report)	No		S E P G
				→One year period prevalence of low back pain (self report)	No		S E P G
				→Lifetime prevalence of low back pain (self report)	No		S E P G
				→Recurrence/persistence rate of low back pain (self report)	No		S E P G
Svensson (1982) Sweden ⁶⁶	Cross sectional	Random sample of 40–47 year old men selected from the census register of the city of Göteborg, Sweden (n=716) / (76%)	Primary school Middle school Upper school Adult continuation school	→Lifetime prevalence of low back pain (insurance data)	No		S L P G
Magora (1970) Israel ⁶⁵	Cross sectional	Subjects chosen randomly from eight selected occupations (n=3316) / (?)	University or others Unclearly stated	→Lifetime prevalence of low back pain for more than 3 days (self report)	Direct		S E L R M P G

*Reference category indicated by §. †No association: there was no statistically significant association. Direct association: statistically significant association where back pain frequency increased with increasing educational status. Inverse association: statistically significant association where back pain frequency decreased with increasing educational status. ‡Major weaknesses pertaining to: S: selection of subjects, Z: sample size, E: measure of education, L: length of follow up, R: drop out rate, O: measure of outcome, M: multivariate analysis, P: point estimates, G: consideration of effect modification by gender.

association of education with the recurrence of back pain.

Overall, the current limited available evidence points indirectly to a stronger effect of education on the duration and/or recurrence of back pain than to an association with onset.

EDUCATION AND THE OUTCOMES OF BACK PAIN EPISODES

Studies of education as a predictor of the outcomes of back pain episodes are summarised in table 2. In 20 instances reported in the 11 major studies, worse outcomes were associated significantly with low education.^{4 58 75–83} Negative results were found in only five instances, reported in two studies.^{76 77} No major studies reported worse outcomes among better educated subjects. The validity of comparing study results is impaired by the heterogeneity of the methods used, including the choice of subjects and the definition of back pain and outcome measures. The following examples illustrate this diversity and the many methodological issues to consider in interpreting their findings.

Badley and Ibañez (1994) used data from the 1986 Canada Health and Activity Limitation Survey (HALS), which included 132 337 non-institutionalised persons aged 16 years and older.⁸¹ More than half of this sample (54%) had some limitation of activity, 8228 from back pain (in neck or back). The authors found an independent association of low education with activity limitation attributable to back pain (≤ grade 8 versus > secondary education: OR=1.25, 95% confidence intervals: 1.11, 1.40). This study used a crude index of disability (a “yes/no” answer to a single question). It had an extremely large sample size that might have caused most associations to be statistically significant.

In a three month longitudinal study of 179 patients presenting with low back pain (pain below T12) to the outpatient clinic of a hospital,⁷⁶ seeking compensation decreased and self rated pain improvement increased with increasing education. No association was found with days of pain, improvement in disability, employment status and the number of visits made to a physician. Education was, however, also strongly associated with the language used by the study subjects (English versus Spanish), which predicted disability in multivariate analyses. Although some findings of this study were replicated using NHANES II survey data, the population under study was largely indigent and Hispanic and not representative of the US population, which may explain why some of the dependent variables were not significantly associated with education.

In a 22 year longitudinal study of 391 male employees of a Swedish company, the longest longitudinal study by far, Åstrand and Isacson (1988) did not find education to be predictive of early retirement with a back diagnosis (disorders in thoracic or lumbar areas). However, they identified a protective effect of education manifested by a relative risk of early retirement for all diagnoses of 0.8 (p=0.004) for each additional year of education. There were few cases of early retirement for back pain

Table 2 Summary of studies on education and the outcomes of back pain episodes

First author, year, country and reference	Type of study	Subjects (n) / (response rate)	Definition of education *	Measure of outcome	Association†	Point estimates	Major weaknesses‡
Major studies							
Hurwitz (1997) United States ⁸⁸	Cross sectional	Multiple random sample of the civilian non-institutionalised population of the US aged 18 years and over (1989 National Health Interview Survey) - (n=84 572) / (94.9%)	(1) < High school graduate§ (2) High school graduate (3) > High school graduate	→Long term (>3 months) back related activity limitations	Inverse	OR (95% CI) (2) 0.90 (0.81, 0.99) (3) 0.79 (0.71, 0.88)	L G
Kearney (1997) United States ⁸⁵	Cross sectional	Social Security Administration's Disability Insurance beneficiaries, Supplemental Security Income recipients, and temporary disability insurance recipients from California and New Jersey, aged <60 years and unemployed for ≥3 months because of back pain (n=924) / (85%)	(1) Kindergarten (2) Grade school (3) Middle school (4) High school (5) 2 year college (6) 4 year college (7) Graduate school (8) Other	→Return to work	Inverse	Prevalence of return to work (%) Sample 1 Sample 2 (1) 0.0 (2) 23.5 (3) 11.8 (4) 28.8 (5) 34.1 (6) 46.5 (7) 77.8 (8) 66.7 Multiple regression coefficient for education (p value)	L M G
Dionne (1995) United States ⁸²	Cross sectional and longitudinal (2 years)	Patients aged 18–75 years who made visits for back pain in 1989–1990 in primary care settings of a large WA state HMO (n=1128) / (72%)	(1) ≤12 years§ (2) >12 years	→Back related functional limitations at baseline →Change in back related functional limitations during FU	Inverse	(2) -5.44 (0.003) (2) -3.48 (0.022)	S L S
Badley (1994) Canada ⁸¹	Cross sectional	Persons with disability aged 16 years and older who lived in private households in Canada in 1986 - Health and Activity Limitation Survey (HALS) - (n=132 337) / (90%)	(3) ≤ Grade 8 (2) Secondary (1) Post-secondary§	→Back related activity limitation	Inverse	OR (95% CI) (2) 0.84 (0.75, 0.93) (3) 1.25 (1.11, 1.40)	L G
Mäkelä (1993) Finland ⁷⁹	Cross sectional	Two stage cluster sample of the Finnish population aged ≥30 years - Mini-Finland Health Survey (n=7217) / (90%)	(1) <8 years (2) 8–12 years (3) >12 years	→Reduced working capacity due to back pain →Occasional need for help due to back pain →Regular need for help due to back pain →Index of pain and disability (at FU)	Inverse	Prevalence of outcome among subjects 30–64 years (1) 31.4% (2) 14.6% (3) 6.2% (2) 10.7% (3) 5.5% (2) 2.2% (3) 0.5% OR (p value) (2) 1.85 (0.005) (3) 3.17 (0.004)	L M L M L M S G
Von Korff (1993) United States ⁸⁰	Longitudinal (1 year)	Patients aged 18–75, making visits to primary care physicians of a large HMO for back pain during 1989–1990 (n=1128) / (72%)	(3) <12 years (2) High school graduates (1) College graduates§	→≥90 days lost from work for a claim	Inverse	OR (95% CI) (2) 0.94 (0.80, 1.10) (3) 0.81 (0.66, 0.99) (4) 0.46 (0.35, 0.60) (2) 1.07 (0.87, 1.33) (3) 0.96 (0.69, 1.35) (4) 0.64 (0.41, 1.01) RR (95% CI)	L E R
Volinn (1991) United States ⁷⁸	Cross sectional	Back sprain claims (insurance data in WA State) - (n=25 093) / (?)	Nam-Powers Socioeconomic Index (1) ≤16§ (2) 17–31 (3) 32–50 (4) >50 Years of schooling	→Early retirement with a disability pension for back pain →Early retirement with a disability pension (all diagnoses)	Inverse (only among men)	Men Women	P G O G
Astrand (1988) Sweden ⁷⁷	Longitudinal (22 years)	Males employees in a Swedish pulp and paper company (n=391) / (83%)	Years of schooling	→Self rated pain improvement (at FU) →Seeking compensation (during FU) →Number of days of pain (during FU) →Improvement in functional ability (at FU) →Number of physician visits (during FU) →Employment status (at FU)	No Inverse No No No No	Regression coefficient for education (p value) -0.193 (0.0095) 0.519 (0.0001)	S Z S Z S Z S Z S Z S Z
Deyo (1988) United States ⁷⁶	Longitudinal (3 months)	Patients aged ≥18 years presenting to an outpatient clinic with uncomplicated low back pain (78% acute) - (n=179) / (88%)	Years of schooling		Inverse		

Table 2 Continued

First author, year, country and reference	Type of study	Subjects (n) / (response rate)	Definition of education *	Measure of outcome	Association†	Point estimates	Mean days	Major weaknesses‡
Deyo (1987) United States ⁷⁵	Cross sectional	Representative of the civilian non-institutionalised US population ≥25 years with low back pain (NHANES II) - (n=1516) / (weighted)	(1) None (2) Elementary school (3) High school (4) College	→Number of days of activity limitations (past year) →Number of days of reduced household activities (past year) →Number of days of bed rest (past year) →Number of days of work absenteeism (past year)	Inverse (only among men) Inverse (only among men) Inverse (only among men) Inverse (only among men)	(1) 173.5 (2) 118.6 (3) 53.1 (4) 28.2 p<0.001 (1) 71.6 (2) 97.4 (3) 37.1 (4) 17.9 p<0.001 (1) 65.1 (2) 15.3 (3) 3.4 (4) 1.7 p<0.001 (1) 159.0 (2) 51.9 (3) 21.0 (4) 8.3 p<0.001		L L L L
Cunningham (1984) United States ⁴	Cross sectional	Subjects with a history of back symptoms from NHANES I survey data: a multistage, stratified probability sample of persons aged 25–74 in the US (n=389) / (weighted)	(1) <12 years (2) ≥12 years§	→Activity restriction (past year) →Change in job status (past year) →≥5 days lost from work (past year)	Inverse Inverse Inverse	OR (95% CI) (1) 1.26 (1.11, 1.43) (1) 1.19 (1.04, 1.37) (1) 1.20 (1.02, 1.43)		L G L G L G
<i>Other studies</i>					No			S Z E M P G
Lehmann (1993) United States ⁶¹	Longitudinal (6 months)	Patients 18–65 years old presenting with acute low back pain problems with work absenteeism >2 but <6 weeks (n=55) / (78%)	Not stated	→Time until return to work	No		p<0.17	
Lancourt (1992) United States ⁸⁰	Longitudinal (6 months)	Consecutive low back pain patients receiving workers' compensation (n=134) / (83%)	(1) <12 years§ (2) ≥12 years	→Work status (at FU)	No			S Z P G
Tate (1992) United States ³¹	Longitudinal (1 year)	Subjects receiving worker compensation benefits from a large automobile manufacturing Michigan employer (n=200) / (?)	Years of schooling	→Return to work (at FU)	Inverse	Average years of schooling Return to work No return to work	12 10	S Z R M G
Cats-Baril (1991) United States ⁸⁸	Longitudinal (6 months)	Patients aged 18–65 who consulted for a new episode of low back pain with ≤3 months off work - (n=232) / (93%)	Not stated	→Work status (at FU)	Association (direction not stated)		p<0.05	Z E M P G
Lee (1989) Hong Kong ⁸⁸	Longitudinal (6 months)	University of Hong Kong Spinal Pain Clinic patients (n=58) / (?)	Years of schooling	→Functional abilities and subjective pain ratings (at FU)	Inverse	Years of schooling Worst outcome Moderate outcome Controls	6.6 8.7 9.6	Z R M G
Lanier (1988) United States ⁸⁷	Longitudinal (6 weeks)	Acute cases of mechanical low back pain presenting to one of seven family practices (n=116) / (93%)	Years of schooling	→Number of days lost from work (during FU)	No			S Z L P G
Murphy (1984) United States ⁸⁸	Longitudinal (6 months)	Male veterans with acute low back pain (<6 months duration) - (n=48) / (66%)	Not stated	→Disability (Roland Scale - at FU) →Chronic/non-chronic (at FU)	No			S Z L P G
Westrin (1972) Sweden ⁸⁵	Cross sectional	Random sample of individuals drawn from the records of members of an insurance company in Gothenburg (Sweden) - (n=428) / (80%) Subjects chosen randomly from eight occupations (n=3316) / (?)	Unclearly stated	→Absence from work of at least 8 days for low back pain in 1964	Inverse	Prevalence of higher education Back pain subjects Controls	7% 20%	E L M G
Magora (1969) Israel ⁸⁴	Cross sectional		(1) Self educated (2) Elementary school (3) High school (4) University	→Sick leave for last episode of low back pain	Inverse	Prevalence of outcome (1) 63.6% (2) 46.5% (3) 35.8% (4) 13.0%		S L R M G

*Reference category indicated by §. †No association: there was no statistically significant association. Direct association: statistically significant association where unfavourable outcome increased with increasing educational status. Inverse association: statistically significant association where unfavourable outcome decreased with increasing educational status. ‡Major weaknesses pertaining to: S: selection of subjects, Z: sample size, E: measure of education, L: length of follow up, R: drop out rate, O: measure of outcome, M: multivariate analysis, P: point estimates, G: consideration of effect modification by gender. FU = follow up.

in this study, which also had the disadvantage of including only blue collar workers with very similar educational backgrounds, making it difficult to contrast differences between education groups.⁷⁷

In one study that aimed specifically at explaining the association between education and the consequences of back pain, 1213 HMO enrollees who consulted a primary care physician for back pain in 1989–1990, were followed up for two years. Low education was associated cross sectionally and longitudinally with back related functional limitations measured with a modified version of the Roland-Morris scale. The statistical associations were explained mostly by combinations of psychological (symptoms of somatisation and depression, patient's expectation of continuous pain), behavioural (cigarette smoking, body mass index) and occupational (handling, kneeling and job strength) factors.⁸² These results have not been replicated yet.

The many reports of a relation of low education with adverse consequences of back pain, even after multivariate adjustment for several variables, suggest that the course of a back pain episode is less favourable among persons with low educational attainment.

EDUCATION AND THE OUTCOMES OF INTERVENTIONS AMONG BACK PAIN PATIENTS

Synthesising the results of studies on the third role of education is much less straightforward. Only two studies among 17 (table 3) met our definition of major studies and both concluded to no association between formal education and outcomes.^{92–93} Other studies found very heterogeneous results. As the study objectives, populations, interventions, outcome measures, statistical techniques, length of follow up and the way education was considered are very different from one study to another, it is particularly difficult to draw firm conclusions from these results.

At this stage of the natural history of the disease, a reduction in the variability of educational attainment could be advanced as a possible difficulty in detecting a difference on outcomes between groups. If less educated people get more episodes of back pain and are also more likely to shift towards chronicity than people with higher level of education, theoretically there must be relatively few people in the highest groups of educational attainment among severe cases, making less easy to contrast differences between groups of education. This seems to be true in several "other" studies where the baseline educational status of subjects was sufficiently described.^{94–103}

Thus, although the limited evidence for an association of educational status with the outcomes of surgical and rehabilitative interventions among back pain patients is negative, this role of education could not be denied yet and needs more research efforts to be understood.

KEY POINTS

- The association between low education and higher frequency of back pain seems to be robust.
- The course of a back pain episode seems less favourable among those with lower education.
- That many health related events are linked to education suggests that low SES increases susceptibility or impairs adaptation to illness.
- Studies on back pain should include formal education as a risk factor of its own.
- Adjusting for education could lead to underestimate the association between variables education is associated with and back pain outcomes.

POSSIBLE UNDERLYING MECHANISMS

The fact that many health related events are linked to formal education suggests that something about low SES or other specific traits linked to education increases susceptibility or impairs adaptation to illness. Five hypotheses that could explain this association are outlined below and explored in the context of back pain. These hypotheses are not mutually exclusive.

Behavioural and environmental risk factors

Persons in lower socioeconomic groups are more likely to live in a toxic, hazardous and non-hygienic environment, resulting in a broad array of disease concerns.^{1–14–73} Besides benefiting from better living conditions, people in the highest groups of education are also more likely to be aware of risks and to adjust their behaviours accordingly.³⁷ Strong evidence exists for the impact on health of cigarette smoking, obesity, alcohol consumption, substance misuse, life changes, chronic stressful events, social support and dietary habits, among others. These factors are often linked with education,^{9–20–30–37–111–114} and there is some evidence for their adverse effects on the back.^{19–53–54–87–115–118} For instance, cigarette smoking has been postulated to act on back pain by way of impaired fibrinolysis and reduced nutrition to intervertebral discs, induction of osteoporosis, and mechanical stress to the spine from increased abdominal pressure provoked by coughing.^{116–119} Obesity is considered to affect the spine by conferring mechanical disadvantages.¹²⁰ Given the current state of knowledge, however, it is difficult to propose any particular combination of these risk factors as a sufficient explanation for the association of education with back pain.

The mechanisms linking psychological factors to back pain are still obscure; anxious or depressed patients may have greater awareness of pain or they may have more difficulty coping with it and consult health care providers earlier. Life stress could also be a precursor of back pain and act directly by an unknown mechanism.^{115–117–121} The work of Pincus and Callahan, who noticed that low formal education was consistently associated with increased

Table 3 Summary of studies on education and outcomes of interventions among back pain patients

First author, year, country and reference	Type of study	Subjects (n)/response rate	Definition of education*	Measure of outcome	Association†	Point estimates	Major weaknesses ‡
Major studies							
Nykvist (1991) Finland ⁹³	Longitudinal (5 years)	Patients admitted to hospital because of severe sciatic pain (n=276 - 179 got some back surgery) / (81%)	No vocational education Vocational course Technical/commercial/high school University	→Vocational handicap (VICIDH - at FU)	No		S Z P
Polatin (1989) United States ⁹²	Longitudinal (1 year)	Four groups of patients from the Functional Restoration Program at PRIDE: a success group; a failure group; a drop out group; and a failed to enter group (n=326) / (?)	Years of schooling	→Return to work (at FU)	No		S R P
Other studies							
Keel (1998) Switzerland ¹¹⁰	Longitudinal (1 year)	Patients aged 20–60 years, admitted for inpatient rehabilitation in rural centres of Switzerland for persistent, intractable, low back pain, and who had been on sick leave for at least 6 weeks during the past 2 years (n=254) / (62%)	Elementary school High school College/university	→Success as defined by work incapacity, physical leisure activities, average pain intensity, general wellbeing, functional limitations and quality of life (at FU)	Inverse		S Z O M P G
Fishbain (1997) United States ¹⁰⁹	Longitudinal (2.5 years)	Chronic low back pain patients aged 19–62 years entering the University of Miami Comprehensive Pain and Rehabilitation Center for a low back problem lasting >6 months (n=128) / (92%)	Not stated	→Return to work (at FU)		Pearson correlation coefficient between education and outcome (statistical significance) One month 2.5 years Average 0.39 (p<0.001) 0.28 (p<0.001) 0.41 (p<0.001) OR (95% CI) (2) 3.2 (1.3, 7.8) (2) 3.3 (1.4, 8.0)	S Z E G S Z R G S Z R G
Vucetic (1997, 1999) Sweden ^{107, 108}	Cross sectional and longitudinal (2 years)	Consecutive patients aged 19–68 years undertaking primary surgery for suspected lumbar disc herniation because of severe sciatica, with clinical and radiographic signs of lumbar disc herniation (n=160) / (?)	(2) High (academics and skilled workers) (1) Low (no further education or vocational training after elementary school)§ Years of schooling	→Ruptured v intact annulus as diagnosed during surgery →Return to work (at FU)	Inverse Direct Inverse		S Z R M P G
Hazard (1991) United States ¹⁰⁶	Longitudinal (2 years)	Consecutive back pain patients with ≥ 4 months of continuous disability from work entering a functional restoration programme (n=258) / (27–77%)	Years of schooling	→Return to work (at FU)	No		
Lacroix (1990) Canada ¹⁰⁵	Longitudinal (mean=13.7 months)	Patients with a work injury involving the low back, with absence from work between 3 and 6 months, referred to the Downsview Rehabilitation Center (n=100) / (?)	Years of schooling	→Return to work (at FU)	No	Pearson correlation coefficient between education and outcome (statistical significance) Sample 1 Sample 2 0.50 (NS) 0.40 (NS)	S Z R M G
Doxey (1988) Canada ¹⁰¹	Longitudinal (1 year)	Compensated workers 19–62 years old randomly selected from candidates for first lumbar surgery (n=116 - 74 had surgery) / (?)	Years of schooling	→Work status (at FU) →Orthopaedic outcome (at FU)	No Inverse (among non-surgery patients only)	–0.03 (NS) 0.30 (p<0.05)	S Z R M G S Z R M G
Fredrickson (1988) United States ¹⁰³	Longitudinal (2.5 years)	Patients admitted to a back rehabilitation programme (n=80) / (?)	Not stated	→Pain relief (at FU) →Return to work (at FU)	No No		S Z E R P G S Z E R P G
Kleinke (1988) United States ¹⁰²	Longitudinal (28 days)	Chronic back pain patients entering the Spaulding Rehabilitation Hospital in Boston (n=72) / (?)	Years of schooling	→Increased activity at home (at FU) →Improvement in pain (at FU) →Improvement in pain behaviors (at FU) →Improvement in depression (at FU) →Improvement in mood (at FU)	No No No No No		S Z R P G S Z R P G S Z R P G S Z R P G S Z S
Hurme (1987) Finland ¹⁰¹	Longitudinal (6 months)	Consecutive patients aged ≥ 55 years with suspected lumbar disc herniation, hospitalised in Turku University Central Hospital or Turku City Hospital (n=215) / (98%)	Not stated	→Patient's evaluation of progress (at FU) →Pain Index (at FU) →ADL Index (at FU) →Combined Index for pain and disability (at FU)	Inverse Inverse Inverse Inverse	p>0.001 p>0.001 p>0.001 p>0.001	S Z E P G S Z E P G S Z E P G S Z E P G

Table 3 Continued

First author, year, country and reference	Type of study	Subjects (n)/response rate	Definition of education*	Measure of outcome	Association†	Point estimates	Major weaknesses ‡
Alaranta (1986) Finland ¹⁰⁰	Cross sectional	Patients <55 years operated one year earlier for lumbar disc herniation (n=212) / (96%)	(1) No vocational education (2) Vocational course (3) School university (4) High school	→Occupational handicap (ICIDH)	Inverse (only among men)	Prevalence of outcome (severe) Men (1) 62% (2) 19% (3) 15% (4) 4% p=0.007 Women (1) 38% (2) 32% (3) 22% (4) 8% NS	S Z L M
Guck (1986) United States ⁹⁹	Longitudinal (5 years)	Patients from a chronic pain programme (32 with back pain) (Midwestern University Medical Center) (n=77) / (85%)	Years of schooling	→Success/failure (Roberts and Reinhardt criteria - at FU)	Association (direction unclear) Inverse		S Z E P G
Oostdam (1983) The Netherlands ⁹⁸	Longitudinal (6 months)	Patients with low back pain admitted to one of departments of neurosurgery in the 2 hospitals in Zwolle (the Netherlands), who had a back surgery (n=150) / (91.5%)	Not stated	→Patient's and surgeon's rating of improvement (at FU)		p=0.0002	S Z E P G
Tunturi (1980) Finland ⁹⁷	Longitudinal (mean=4.8 years)	Patients aged 16 to 59 years subject to posterior fusion of the lumbosacral spine in Finland (n=102) / (?)	Years of schooling	→Postoperative working capacity (at FU)		p<0.05	
Kokan (1974) Canada ⁹⁶ Wilfong (1973) Canada ⁹⁵	Longitudinal (2 to 9 years)	Subjects from a veteran population of male patients who had undergone lumbar intervertebral fusion(s) at Shaughnessy Hospital for relief of low back pain (n=28) / (34–36%)	Years of schooling	→Orthopaedist's rating of the success/failure of fusion in restoring each patient to normal functioning (at FU)	Inverse No	Pearson correlation coefficient between education and outcome (statistical significance) 0.28 (statistically significant) Mean years of formal education by outcome category Good 9.4 Fair 10.1 Poor 8.1 NS	S Z R M G S Z R O M G
Narvig (1970) Norway ⁹⁴	Longitudinal (1 year)	Consecutive patients with low back pain entering the State Rehabilitation Institute of Oslo (n=185) / (60%)	Unclearly stated	→Return to work or school (at FU)	Inverse	Pearson correlation coefficient between education and outcome (statistical significance) 0.53 (p<0.001)	S Z E R M G

*Reference category indicated by §. †No association; there was no statistically significant association. Direct association: statistically significant association where unfavourable outcome increased with increasing educational status. Inverse association: statistically significant association where unfavourable outcome decreased with increasing educational status. ‡Major weaknesses pertaining to: S: selection of subjects, Z: sample size, E: measure of education, L: length of follow up, R: drop out rate, O: measure of outcome, M: multivariate analysis, P: point estimates, G: consideration of effect modification by gender. FU = follow up.

morbidity and mortality in rheumatoid arthritis, has lead to identify other important psychological variables (helplessness and hostility) that might become the focus of future interventions.^{6 7 12 122–126}

Occupational factors

It is widely believed that a hazardous work environment and physically demanding jobs play an important part in the aetiology of back pain.^{65 84 127 128} People with low education and low paying jobs are more likely to work in physically demanding jobs and tasks involving stresses on the spine. After an episode of back pain, they may have to wait longer to resume a demanding job than persons with sedentary occupations.^{4 8 20 41 49 75 84 129 130} They may be less satisfied with their jobs and less motivated to continue working or to work as hard after an episode of back pain.^{5 76} Conversely, persons with low education may have poorer sick leave benefits or fear loss of their jobs because of back pain, and be more prone to return to a physically demanding job before the back injury has resolved, risking reinjury or prolongation of symptoms.⁵¹ This explanation was not sufficient, however, to account for differences in outcomes across educational groups in several studies.^{1 18 19 60 75 100 151} For instance, Leigh and Sheetz (1989) found a significant association between back pain period prevalence and low education even after adjustment for other risk factors, including occupation, physical demands and repetitiveness of work.⁵⁴ Although these results suggest that occupational factors alone are not sufficient to explain the association, the findings may have resulted from imperfect classification of occupation and physical demands of the job, as these are difficult to measure and classify.¹³²

Compromised "health stock"

In the perspective of Grossman's application of consumer theory to health care, a person's health is viewed as capital ("health stock") that is inherited and reduced by depreciation (biological aging) and finally by death, when the capital falls below a certain minimal level.¹³³ There is some evidence that socioeconomic circumstances during childhood may influence adult health by compromising this "health stock" at the beginning of adult life.²⁰ This hypothesis is compatible with the "pain prone disorder" suggested in the literature on back pain.¹³⁴ In a study on pre-morbid social adjustment of chronic back pain sufferers, the subjects were found to have limited formal education.¹³⁵ "Most had experienced unmet dependency needs...and many had familial models for pain and disability present in their early life experience". The study of Porter and Oakshot,¹³⁶ who observed a higher prevalence of small adult vertebral canal among subjects with lower education (as a marker of early impairment of growth) also supports this hypothesis.

Health services access and utilisation

Differential access to or use of health services across groups of education, or differences in the benefits obtained from the use of health care are other possible explanations to account for the relation between education and health.^{1 4 12 14 24} People of lower SES do less well in the health care system, although the reasons for this are unknown.²⁴ One hypothesis is that low education would impair communication and trust with health professionals, and make it more difficult to use services effectively.²⁴ For back pain, it is possible that patients with lower education have less access to some specialised interventions, wait longer before consulting or have lower compliance with health professionals' recommendations. However, several reports found that people with back pain in low education groups more often consulted a physician and were more frequently hospitalised.^{1 9 20 37 50} In a national US survey, the relation between education and duration of back related disability was unexplained by medical care utilisation. There was a significant trend toward more frequent hospitalisation among those with less education. The proportion of subjects who had sought medical care or had undergone back surgery was similar in each educational group.⁷⁵ These results are in agreement with the conclusion of a recent paper by Pincus *et al* (1998) on access to care as a determinant of health, in which the authors demonstrate, on the basis of many international studies (several of them from countries with longstanding universal access to medical care), that widening disparities in health according to SES are not explained mainly by access to care.¹³⁷ The association between education and back pain thus seems unlikely to be explained by differences in the use of health services.^{1 11 14 19 20 81 122}

Adaptation to stressful events

There is evidence for the joint effect of stressful events and an altered social environment as an explanation for the relation between SES and health.^{2 4 14 19 84 138} Such an effect would be explained as an opportunity for pathogenic agents (stressful events) to affect health when host resistance is lowered by way of endocrine or immunological changes. There are two major circumstances in which the social environment might impair host resistance: (1) when the person is unprepared to function in their social setting and fails to receive adequate feedback that their problem solving efforts are effective and (2) when there is a deficiency in the social support provided by the primary group. This mechanism is supported by studies on animals.¹³⁹ In humans, this hypothesis may explain the increased risk of mortality from myocardial infarction among men with low educational achievement. Men who are socially isolated and experience important changes in their life are more likely to die than others.^{34 35} In view of the current dominant theory of pain¹⁴⁰ such an effect may operate on back pain by influencing the central mechanisms that modulate the transmission of nociceptive messages to the brain, facilitating pain that persists

after the original injury, leading to chronicity. Obesity, cigarette smoking, alcoholism, type A behaviour and neurotic diseases may all be considered as responses to stress.¹ This hypothesis, tested in only one back pain study to date, has not been supported.⁸²

Recently, Kubzansky *et al* (1999) found a strong association between education and allostatic load, a measure of biological risk across several systems, that was explained by a measure of "hostility", a broad concept associated with "a tendency to devalue the worth and motives of others, to expect that others are likely to be doing wrong, to view one's self as being in opposite toward others, and to desire to inflict harm or see others harmed". Hostility would develop as a response pattern to difficult life circumstances.¹⁴¹ The authors concluded that lower levels of education and greater hostility are associated with greater "wear and tear" on the body and that the relation between education and allostatic load may be mediated by hostility. This mechanism needs to be studied further.

SUGGESTIONS FOR FUTURE RESEARCH

Frequent methodological problems that affected the results of studies reviewed for this paper include: reliance on cross sectional study design and prevalence of outcomes; inconsistency in defining "back pain", education, interventions, outcome measures and length of follow up; selection bias; limited variability in educational status, making it difficult to find differences between groups based on educational status; and low statistical power because of a small number of outcome events. The diversity of the populations studied may also have contributed to variation in results. Many studies limited their analyses to bivariate relations, while others used multivariate models.

As back pain investigators are still looking for strong and modifiable risk factors, many studies examine as many variables as possible. Although such "fishing expeditions" are necessary as a first step toward the identification of major risk factors, hypothesis testing research must focus on a limited number of variables and develop further knowledge of their impact on the disease. Education is a good candidate for this purpose. Studies on back pain should include it as a risk factor on its own. Measuring education as a continuous variable (years of schooling) should be preferred to categorical classifications, and a clear description of the way it is considered in the analyses should be provided. Multivariate analysis methods allowing adjustment for confounding factors should be used to extend bivariate and correlation analyses. Reporting statistical power or confidence limits in studies that did not find statistically significant associations would also be helpful. Determining if education is related to both incidence/recurrence of back pain (or back related disability) and duration of episodes would certainly be an important contribution to the field. Clarifying the role of sex as an effect modifier would also be valuable, as the literature is very inconsistent on this point.

Few reports among the 64 reviewed for this paper were developed specifically to examine the relation of sociodemographic variables with the outcomes. More research efforts geared toward testing specific hypotheses are needed. Prospective studies on subjects with no prior history of back pain seems to be the most promising study design to this end, and a *sine qua non* condition to answer some questions, particularly those dealing with the directionality of associations.

Another key question concerns exposure measurement; many suspected risk factors are complicated constructs that require care in their measurement, a need more likely to be met in prospective studies. This is certainly the case for psychological factors and job requirements. Studies of the effect of interactions between stress and coping strategies are also needed. Heterogeneity in the definition of study subjects, back pain, interventions, outcomes and length of follow up was a constant concern during our review. Although it is difficult to reach a consensus to define these parameters, the field would certainly benefit from a restriction to some commonly used definitions.

The association between education and back pain has an important immediate implication: adjusting for educational status in multivariate analyses could lead to underestimation of the association between some independent variable education is associated with (for instance, cigarette smoking) and back pain outcomes. It thus seems advisable to compare results obtained with and without adjustment on educational status in aetiological research on back pain.

Conclusion

Scientific evidence supports the hypothesis that less well educated people are more likely to be affected by disabling back pain. However, the evidence is stronger for an effect of education on the duration and/or recurrence of back pain episodes than for an effect of education on the incidence of back pain. Educational status may be a "marker" for other factors involved in the aetiology or natural history of the disease, acting as a proxy for SES. Back pain is still an enormous public health problem in all Western societies.⁴⁴⁻⁴⁸ Despite extensive research work, our understanding of the aetiology and natural history of this condition is still very limited. While the contribution of some risk factors has been highlighted, the search toward the development of a model that accounts for occupational, sociodemographic, biological and psychological characteristics must be pursued. Few traits have demonstrated as a strong and consistent association with back pain as education. It may well be a pathway to a better understanding of this illness and certainly deserves scientific attention.

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