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EDUCATION AND THE PREVALENCE OF PAIN

Steven J. Atlas
Jonathan S. Skinner

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ABSTRACT

Many Americans report chronic and disabling pain, even in the absence of identifiable clinical disorders. We first examine the prevalence of pain in the older U.S. population using the Health and Retirement Study (HRS). Among 50-59 year females, for example, pain rates ranged from 26 percent for college graduates to 55 percent for those without a high school degree. Occupation, industry, and marital status attenuated but did not erase these educational gradients. Second, we used a study of patients with lower back pain and sciatica arising from intervertebral disk herniation (IDH). Initially, nearly all patients reported considerable pain and discomfort, with a sizeable fraction undergoing surgery for their IDH. However, baseline severity measures and surgical or medical treatment explained little of the variation in 10-year outcomes. By contrast, education exerted a strong impact on changes over time in pain: just 9 percent of college graduates report leg or back pain "always" or "almost always" after 10 years, compared to 34 percent for people without a high school degree. This close association of education with pain is consistent with recent research emphasizing the importance of neurological – and perhaps economic -- factors in the perception of pain.

Steven J. Atlas
General Medicine Division
Massachusetts General Hospital
50 Staniford Street
Boston MA 02114
satlas@partners.org

Jonathan S. Skinner
Department of Economics
6106 Rockefeller Hall
Dartmouth College
Hanover, NH 03755
and NBER
jonathan.skinner@dartmouth.edu

I. Introduction

There is considerable evidence that low educational attainment is associated with poor health. Life cycle models of human capital model (e.g., Case and Deaton, 2005) imply that lower education workers will depreciate their physical health more rapidly, leading to strong education-based differentials in health and disability for older ages. As well, there are educational differences in nutritional habits, access to health care, and differences in cognition and the understanding of health risks (Cutler and Lleras-Muney, 2006). In this paper, we consider pain, which is both associated with poor health but which also reflects an important dimension of well-being (Krueger and Stone, 2008; Kahneman and Krueger, 2006). Many clinical health conditions can cause pain, but in practice the link between pain and organic bodily disorders, such as disc herniation of the spinal column, are tenuous at best. For example, one-half of asymptomatic people – people who are not in pain and function normally -- exhibit objective signs of spinal abnormalities on their MRIs (Jensen, et. al., 1994). The reverse is also true; people without any discernable clinical evidence of back disorder may be immobilized by excruciating pain (Chou et al., 2007).

One of the few studies in economics to consider the role of pain is Kapteyn, Smith, and van Soest (2006), who find that people "troubled with pain" are far more likely to report a disability that prevents them from working, which in turn substantially raises the likelihood of leaving the labor force.[1] Another study by Krueger and Stone (2008) used a 24-hour diary survey to find one-third of respondents between ages 50-59 reporting some pain, with higher rates among people with lower income. In this paper, we first use the 2004 Health and

[1] Blanchflower (2008) has also considered pain as a dependent variable; his results are discussed in more detail below.

Retirement Study (HRS) to document the dramatic differences across educational groups in the prevalence of pain. We find differences across educational groups, with rates of people aged 50-59 troubled by pain ranging from 26 percent for women with a college education to 55 percent for those without a high school diploma.

An obvious explanation for these differences is that people with lower education are more likely to have worked in manual jobs, or to experience other types of poor health. We can partially control for such differences using controls in the HRS for occupation and industry, factors which appear to matter but which do not dislodge the fundamental result that education matters a great deal for the realization of pain. But we are still concerned with the possibility of long-term unobserved health factors that may be associated with education. As well, we would like to test the hypothesis that education affects *changes* over time in pain.

For this reason, we also consider the importance of pain using data from the Maine Lumbar Spine Study, which followed patients with intervertebral disk herniation (IDH) over a 10-year follow-up period. This unique study provided detailed clinical baseline information for a sample of people with a common clinical complaint of lower back pain associated with sciatica (referred pain down the leg) arising from IDH.[2] We consider education-based differences in the long-term prevalence of pain with treatment, and whether these differences can be explained by underlying clinical health at baseline, or by access to surgical or other medical treatments.

The initial severity of the IDH, as measured by imaging or clinical diagnosis, explains just a small degree of variation in outcomes. Surgery has limited explanatory power in long-

[2] We therefore exclude all patients who do not have clear objective evidence of a specific cause for their lower back pain. All patients were required to have symptoms of sciatica that were thought due to a herniated disc. Eligibility criteria did not require imaging data for enrollment, however.

term pain, although surgery has been associated with modest outcome benefits (Atlas, et. al., 2005; Weinstein et. al., 2006a,b). The most important predictive factor of long-term pain outcomes is education. Even after 10 years, the percentage of people who experience leg or back pain "almost always" or "always" is 34 percent for high school dropouts but just 9 percent for college graduates.

Why then is pain so much greater among lower educational (or income) groups? One explanation is that people report pain to justify non-employment and disability. However, there is modest evidence for this explanation from the economics literature (e.g., Benitez-Silva, et. al., 2004), as well as a growing clinical and neurological literature rejecting the idea of people falsely reporting pain. Instead, this new view recognizes the importance of the brain in generating *real* pain in specific areas of the brain, even in the absence of a specific physical injury (Melzack, 1993; Apkarian, Baliki, and Geha, 2009).

As well, there is evidence that this complex process of pain may respond to psychosocial factors or even economic factors that are likely to be associated with education, for example in the repetition strain injury (RSI) epidemic in Australia, which swept across some (but not all) regions before disappearing in the late 1980s (Gawande, 2002). The strong association between education and the prevalence of pain in both the HRS and the Maine IDH data are supportive of the view that educational attainment is associated with social or even economic factors that affect the neurobiological processing and perception of pain.

II. The Prevalence of Pain in the Health and Retirement Study

The Health and Retirement Study (HRS) is a nationally based longitudinal study of people age 50+. The simplest comparisons focus on the question: "Are you often troubled by pain?" The initial sample size for people aged 50+ was N = 10,561 (women) and N = 7,841 (men) providing valid answers to the pain question. The unadjusted comparisons are shown in Table 1 by three educational groups: 11 or fewer years of education, high school graduates and some college (12-15 years), and college graduates (16+ years).

Overall, the prevalence of pain among women 50-59 years old is substantially higher among those who did not finish school (55 percent), more than double the rate for women of the same age with a college degree (25 percent, $p < .01$), and still substantially higher than for women with high school degrees (36 percent). In general, the prevalence of pain is lower among men, which may be the consequence of differences in disease prevalence. But a similar educational gradient is observed for them as well, with a rate of 42 percent among those who did not graduate from high school, compared to 19 percent for college graduates.

Individuals reporting pain were also asked in more detail about the severity of the pain. These tabulations are shown in Figures 1a (for women) and 1b (for men) for ages 50-59. The percentage of "no pain" respondents is simply 100 minus the percentage of people reporting pain in Table 1, but with more detailed gradation of whether the pain is mild, moderate, or severe. The educational gradient carries over with regard to severity of pain. For women in this age group, mild pain is similar across education groups (10.8 percent for those without a high school diploma, compared to 10.1 percent for college graduates), moderate pain is substantially greater (28.2 percent for the lowest education group, compared with 21 percent for high school graduates and 12 percent for college graduates), and there is a five-to-one difference for severe pain (15.9 percent for those not finishing high school compared to 2.9 percent for college graduates). A similar pattern is shown for men; for the lowest education group, 10.5 percent report severe pain, compared to 1.6 percent for college graduates.

One might expect rates of reported pain to rise with age, but the opposite pattern is observed, at least among those with lower educational attainment. (Rates rise somewhat for college graduates.) As well, the education gradient largely disappears among older ages. For example, among women age 80-89, 33 percent of those not finishing high school report pain, compared to 30 percent for college graduates.[3] Somewhat more report severe pain, 8.6 for the lowest education group compared to 5.4 for college graduates. For men age 80-89, the rates are nearly identical; 29 percent in the lowest and 28 percent in the highest education groups report pain, with 6.9 versus 6.6 percent reporting severe pain.

One could explain these differences as a cohort effect, that these younger people were more likely to experience pain because of differential labor market experiences, although this hypothesis does not receive support from additional waves of the HRS.[4] Another possibility is differential mortality rates, so that there are simply fewer (and healthier) people who didn't finish high school in the sample by age 80-89, but selection bias would have to be extreme to cause the large gradient observed at age 50-59 (and age 60-69) to disappear so quickly.

One explanation for these educational gradients is past work experience. In Case and Deaton (2005), individuals with lower educational attainment may depreciate human capital more rapidly. For example, working in physically demanding occupations earns a wage

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[3] See also Krueger and Stone (2008) who consider a broader sample of age groups; they find pain rising again among people 90 and older.

[4] One might also speculate about an experiential difference between younger and older cohorts if the cultural acceptance of pain (pain as the "5th vital sign") may be more ingrained in younger cohorts. It is less likely that younger patients have received less care for their pain than older individuals.

premium, but the longer-term impact will adversely affect general health, for example through injuries, arthritis, or chronic back pain by the time they reach age 50, implying that low educational attainment workers would experience much higher rates of pain. Thus we attempt to control for occupation and industry, as well as other factors, in explaining the education-based gradients in pain.

Table 2 presents a regression analysis, stratified by age group (50-59, 60-69, and 70-79) but including men and women in the same analysis. For ease of interpretation, we use a simple OLS regression analysis, with robust standard errors. Column 1 shows the simplest regression analysis by education for age 50-59. Black respondents were less likely to report pain (-4.7 percent, $p < .05$), while female gender, as noted earlier, was positively associated with reported pain (9.3 percent, $p < .01$). Marital status also matters; relative to married couples, widowhood is positively associated with pain (4.2 percent, $p < .05$), but only for ages 50-59; at older ages either the effects are small or not significant. However, being divorced is strongly associated with reported pain (15.8 percent, $p < .01$), with gradually declining effects for older age groups. Neither being separated, or never married, is associated with differential levels of pain.

We also included the log of weight (in pounds), along with a squared term. The impact of weight on pain is minimized at 117 pounds (the minimum of the quadratic), with large associations between low-weight, and high-weight status on pain. The low-weight status may reflect a wasting disease (there are relatively few in this category) while obesity is likely associated with arthritis and other ailments.

The association between education and reported pain is strong. Relative to those who did not finish high school, high school graduates are 13 percent less likely to report pain (p <

.01), and college graduates are 25 percent less likely ($p < .01$). The disparities decline at older ages; Column (3) shows 4.2 lower reported pain for high school graduates (8.5 percent lower for college graduates) among those aged 70-79.

Columns (4) and (5) in Table 2 report coefficients from regressions which include individual occupational and industry variables in the HRS. Occupation matters a great deal; Figure 2 shows the marginal impact of occupation on the prevalence of pain for the age 50-59 group, evaluated at the sample means for education, race, marital status, and weight. (Industry effects were more modest and are not reported here.) These predicted pain measures ranged from 25 percent (managerial) and 29 percent (professional and sales) to 43 percent (services: private households, cleaning and building support) and 58 percent (armed forces). While the educational gradient is attenuated, there still remains a substantial difference of 10 percent in pain between the lowest educational group and high school graduates, and a 17 percent gap for college graduates aged 50-59. Including occupation and industry dummy variables had almost no impact on the educational gradients for age 60-69.

Table 3 presents additional ordered probit regressions with the ordering equivalent to no pain (0) through severe pain (3), controlling for occupation and industry. The coefficients on education remain significant, although the magnitude of the coefficients is (again) smaller for ages 70-79. While the interpretation of marginal effects are complicated in ordered probits, note that the coefficient on college education, roughly one-half for ages 50-59 and ages 60-69, is more than double the difference in the index between mild and moderate pain (cut point 2 minus cut point 1) and half the difference between moderate and severe pain (cut point 3 minus cut point 2). Thus education remains a key factor in both the presence and severity of pain.

These measures are consistent with an independent association between education and pain, but we acknowledge that this analysis is more suggestive than definitive. For example, income may be the important mediating factor which is correlated with education. However, concerns about the endogeneity of income are particularly important here – especially in light of Kapteyn, Smith, and van Soest (2006)'s finding that pain is a key mediating factor for leaving the labor force. Similarly, we may be missing other measures of underlying health, but again these are potentially endogenous (self-reported health is likely to be affected by the perception of pain) or the consequence of ready access to primary care (knowing that one suffers from hypertension). For these reasons, we turn to data on changes over time in the prevalence of pain for patients all of whom are suffering from herniated discs, and with detailed baseline data on the severity of their disease.

III. Changes over Time in Back Pain: The Maine Lumbar Spine Study

There is an extensive literature describing the epidemiology of back pain. One study of Michigan workers found compensable back strains occurred in 1.7 percent of handlers and laborers annually, compared to just 0.04 percent among executives (Gluck and Oleinick, 1998). But most studies do not find that physical tasks are the primary cause for chronic back pain. Even after controlling carefully for differences in occupation, low-education workers in Norway were far more likely to leave the labor force disabled (Hagen, et. al., 2000). Similarly, there is a strong impact of education and income on days lost for homemakers, a difference that seems unlikely to be explained entirely by differences in types of work performed by homemakers with (e.g.) high versus low education (Deyo and Tsui-Wu, 2005). One study of San Francisco transit workers suggest that while job tasks have some impact on spinal injuries, other factors related to stress and psychosocial issues have more important predictive powers.(Krause, et. al., 1998; also see Waddell, 2004).

The Maine study was a prospective observational study of patients presenting with sciatica due to an intervertebral disc herniation (IDH) or lumbar spinal stenosis. Patients were treated by orthopedic surgeons, neurosurgeons, and occupational medicine physicians in community based practices throughout the state of Maine. Details about the study design, methods, and outcomes have been published elsewhere (Keller, et. al., 1996; Atlas, et. al., 1996; Atlas et. al., 2005). Our primary interest is in the 403 patients enrolled in the trial with sciatica due to an intervertebral disc herniation (IDH) enrolled between 1990 and 1992, and who were followed up after 10 years (or who died during the 10-year period).[5] Because the objective of the original study was to compare surgery with non-surgical treatments, enrollment was stratified to obtain roughly equal numbers in these treatment groups. In addition, oversampling of patients with IDH receiving workers' compensation was achieved by enrolling patients from occupational medicine practices. (Thus the sample was not designed to be representative of the general population with sciatica.) Specific radiographic findings were not required for study entry but were available for about half of the patients.

For eligible consenting patients, baseline interviews were conducted in person by trained research assistants, with follow-up obtained by mailed questionnaires. Physicians completed a baseline questionnaire including history, physical examination findings, diagnostic procedure results, and planned treatment. Patient data collected at baseline included demographic information, employment and disability status, co-morbid conditions, past spine history, symptoms, and functional status. Generic health status was assessed at

[5] There were 507 patients in the original sample.

baseline with the Medical Outcomes Study Short Form 36-item questionnaire (SF- 36). The SF-36 describes 8 domains of health with each scored from 0 (poor health) to 100 (optimal health).

We assessed two measures of pain and functioning specific to low back or leg pain, which for editorial ease will be referred to as generic "back pain." (The leg pain arises from sciatica, a common symptom of IDH.) The first measure, the modified Roland-Morris Score, assesses back-specific functional status which ranges from 0 to 23 depending on the number of "true" responses to statements about how the patient's life has been affected by back pain (Patrick et al, 1995). Items include: "I stay at home most of the time because of my back," "I stand up for only short periods because of my back," and "Because of back pain, I am more irritable and bad tempered with people than usual." (See the Appendix for the full set of questions.) Questions may ask about difficulty in doing jobs around the house, but questions about job issues or whether the back pain makes it difficult to work are avoided. Thus these questions are not subject to the usual potential endogeneity arising from people reporting illness to justify their non-working status.[6]

The second measure is the frequency of low back pain, leg pain, leg or foot weakness, leg numbness, and leg pain after walking. There is a 7 point scale which we collapse to focus just on the two most severe answers: "almost always" and "always."[7] Follow-up from year 5 to year 10 for the sample was very good, 352 of the original 403 people remained at the end of the sample, with a small degree of attrition (3 percent) owing to death.

[6] Although such reverse causation appears modest at best; see Benitez-Silva, et. al., 2004.

[7] We first find the part of the body with the most severe pain and use that measure as our summary score.

Table 4 presents summary statistics of key variables in the analysis, stratified by education: no high school diploma (N = 47 at baseline, N = 35 for the 10-year follow-up), high school graduates plus some college (N = 249 at baseline, 204 at follow-up), and college graduates (N = 122 at baseline, 113 at follow-up). The average age in the sample was 40, with little difference across educational groups. However, 15 percent of those without a high school degree were female, compared to 39 percent among college graduates.

The Quebec Severity Score, a standard way to grade the severity of spine disorders (Atlas, et. al., 1996), did not differ substantially at baseline across educational groups. However, severe IDH based on an imaging test was higher for college graduates (15 percent) compared to people who hadn't finished high school (2 percent). These percentages are relative to the entire population, including those for whom imaging tests were not available, but the ratio of those with missing data was similar across educational groups; 45 percent for people not finishing high school compared to 52 percent for high school and college graduates.[8]

Baseline factors likely to predict poorer health outcomes were higher for those with lower educational attainment. Fifty-seven percent of those without high school graduates were smokers, significantly greater than 29 percent among college graduates. Similarly, other markers of health, such as the SF36 bodily pain score and the SF36 physical function score, were higher among people with more education. The baseline Roland-Morris score was slightly worse among high school dropouts (16.8) and high school graduates (16.3) than college graduates (14.6), but back pain was clearly disrupting normal life among all education

[8] Missing data means that the researchers were not able to obtain records of the images, not that the physician did not perform the imaging test. But even when imaging information is not available, there are well-established clinical methods for diagnosing IDH based on (e.g.) the presence of sciatica and physical examination findings.

groups. The percentage of people who “always” or “almost always” experienced back or leg pain was 79 percent for those with high school education (or less), and 73 percent for college graduates.[9]

Surgery is often used to treat IDH, although the clinical effects moderate over one to two years (Atlas 1996, Weinstein, 2006a,b), and the benefits largely dissipate over a 10-year period (Atlas, 2005, Weber 1983). Surgical procedure rates were 40 percent among high school dropouts and 35 percent for those with college education (p = 0.78), so it is unlikely that access to surgery per se can explain the educational gradient. Similarly, the percentage of patients taking narcotic pain medicine did not differ significantly between the lowest and highest education groups (p = 0.18).

The bottom of Table 4 includes the identical Roland-Morris and pain measures, measured 10 years later. On average, respondents are far better off than they were at baseline. And here the educational gradient becomes quite pronounced (p < .01), with an average Roland-Morris Score of 3.4 for college graduates, half the value for high school graduates (8.0) and one-third the average for those not finishing high school (10.8). Similarly, the percentage reporting pain always or almost always ranges from 34 percent for people without a high school degree to just 9 percent for college graduates (p < .01).

The differences in pain outcomes by education hold across the entire distribution of disabling pain. Figure 3 shows the distribution of Roland-Morris measures by education, broken into four groups; little pain (< 4 questions answered in the affirmative), mild (4 – 9 questions), moderate (10 – 15) and severe (16 – 23). Just 27 percent of respondents without a high school degree report little pain, fewer than those reporting severe pain (30 percent). By

[9] There was also a higher 10-year rate of mortality among the lowest education group (6 percent compared to the average of 3 percent).

contrast, among college graduates 68 percent report little pain, substantially more than the 5 percent who continue with severe pain.

We therefore consider the association between pain and education in a multivariate context, with the general model written as

$$Y_i = X_i\beta + Z_i\gamma + E_i\alpha + u_i$$

where Y_i is the pain outcome at year 10 following baseline for individual i, X_i represents individual-specific characteristics such as age and sex, Z_i is the set of baseline severity characteristics such as imaging results, initial pain levels, and comorbidities, while E_i is a matrix of categorical measures of education.

Least squares regression results are presented in Table 5, with the excluded educational category corresponding to 11 years of education or fewer. In Column (1), which controls just for sex and age, the coefficient for college graduates is -7.32 ($p < .01$), and for high school graduates, -2.69 ($p < .05$). Column (2), which adds a limited set of baseline covariates (Z) raises the R^2 from 0.15 to 0.25, with smoking, the presence of comorbidities, and the baseline Roland-Morris Score, significant and in the expected direction. (One might interpret the baseline Roland-Morris Score as also capturing individual-level heterogeneity in the overall perception of pain.) The education gradient is somewhat less steep; the coefficient for college graduates is now -5.83 ($p < .01$). Finally, adding all baseline and treatment covariates (Column 3) has little impact on the coefficient for college education (-5.32, $p < .01$).

The Roland-Morris pain measure may be a little difficult to interpret, but the measure of whether one experiences back/leg pain “almost always” or “always” (that is, severe pain) may be easier to intuit. (Least-squares regression is used for ease of interpretation, but probit regressions yielded similar results.) As shown in Column (4) in Table 5, the education gradient is a 24 percentage point difference in the percentage of people reporting severe pain between those in the highest and lowest education group. After controlling for all baseline measures, the corresponding gap is still 13 percentage points, as shown in Column (5). While this coefficient is marginally significant for those with college education, and not significant at all for high school graduates, the corresponding estimates are highly significant using an ordered probit equation with all responses to the question, from never experiencing back-leg pain to always experiencing it.

IV. Discussion and Conclusion

In this paper, we have explored the association between pain and education, and found first that the prevalence of pain exhibits a strong association with education among older (age 50 plus) Americans in the HRS. While previous occupation and industry, as well as marital status, accounts for some of this correlation, there remains a strong and persistent association, at least among ages 50-79.

We also considered how education was associated with the resolution of pain over time. The Maine study included patients with an IDH, a condition which has a specific pain complex that is verifiable in most cases based upon examination and imaging findings (Atlas 2006). Thus, unlike non-specific low back pain in which examination and imaging findings are less reliable, IDH represents a specific low back disorder in which it is more difficult for patients to report sciatic pain without evidence for an underlying clinical disorder (Atlas 2007). Nevertheless, after 10 years, patients with lower educational levels report more pain and functional disability despite objective evidence for the same underlying clinical condition and similar or less severe findings. These effects suggest that education matters for *changes* over time in pain, and swamp any impact of medical or surgical treatments for IDH.

Economists and other social scientists have become increasing interested in the measurement of both health and well-being. Typically health has been measured using diseases known to the respondent (such as hypertension or diabetes), actual measures of blood pressure, hemoglobin A_1c,(e.g., Banks, et. al., 2006), and activities of daily living (ADLs) and instrumental activities of daily living (IADLs). These are relatively objective measures that, absent measurement error, should be stable, trend with age, or shift in response to health events. At the other end of the spectrum is "well-being," which is inherently subjective, and is typically measured by asking respondents about their happiness or satisfaction with their life, or with more focused approaches such as day reconstruction diaries which asks respondents to describe their day and how they felt during each episode (Kahneman, et. al., 2004). Subjective measures have their drawbacks, however, as they can be sensitive to seemingly irrelevant factors such as whether the weather was nice on the day of the survey (Kahneman and Krueger, 2006).

Pain lies somewhere between these two approaches. The study of pain, both in clinical and laboratory settings, occupies a very large literature, with several journals devoted solely to this topic, but economists do not typically consider it.[10] Though pain is self-reported, quantitative measures of pain and its impact have been validated and are widely used (Patrick et al, 1995; Deyo et al 1998; Bombardier, 2000), and prospects for more objective measures of pain using scans of brain activity are improving but are still controversial (Miller, 2009).

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[10] For example, the eponymous journal *Pain* publishes 21 issues per year. A jstor.org search of the word "pain" in all economics journals (in either the abstract or the title) yielded no relevant matches; a typical unrelated matche was an 1894 article in the *Quarterly Journal of Economics* by David I. Green entitled "Pain-Cost and Opportunity-Cost."

In an analysis of country-level averages of pain and happiness, countries with the highest reported pain levels (e.g., Poland, Slovakia, Czech Republic, Slovenia, and Bulgaria) also tended to do worse on measures of happiness and life satisfaction (Blanchflower, 2008). It is perhaps not surprising that there is a close association between pain and subjective well-being, as in Krueger and Stone (2008). Krueger et al. (2007) have recently proposed a new index measuring the fraction of time spent in an "unpleasant" state, which includes episodes of pain. Furthermore, there is neurological evidence that chronic pain has long-lasting effects on the organization and functioning of the brain, including atrophy (Apkarian, et al., 2004; Apkarian, Baliki, and Geha, 2009).

Subjective measures of pain have been viewed with suspicion by economists, given the possibility of people who aren't working or eligible for disability insurance justifying their work status by claiming disabling pain. Questions are often framed to encourage such an interpretation – for example, asking the respondent whether they have a disability which prevents them from working. Most recently, Benitez-Silva, et al. (2004) suggests little self-reporting bias, and in any case none of the questions considered here are related to work decisions. Instead they ask about how general pain (HRS) or specific aspects of back pain with respect to sleeping, walking, or household tasks (see Appendix).

In the clinical and neurological literature, there is an increased recognition that organic signs of injury are not necessary for real pain to occur (Chou et. al., 2007). Atul Gawande (2002) described the case of Rowland Scott Quinlan, an architect who in his 50s was stricken with reoccurring back pain. Numerous physicians could find no physical explanation. There was no financial reason for him to fake pain, but Gawande nonetheless asked his wife about whether she thought he ever faked it:

> She has seen the pain defeat him in ways that she knows he is too proud to fake. He'll try to carry the groceries, and then, shamefaced, have to hand them back a few moments later. Though he loves movies, they have not been to the cinema in years. There have been times when the pain of movement has been so severe that he has soiled his pants rather than make his way to the bathroom. (p. 117)

While Mr. Quinlin continued to work as best he could, for most people this type of pain leads to disability which in turn leads to a total withdrawal from the labor force (Kapteyn, Smith, and van Soest, 2006).

Recall in the Maine study that nearly everyone in the sample was in severe pain at baseline, with most making the transition from acute pain to recovery. The key puzzle is why the fraction of people making the unhappy transition into long-term chronic pain (and often permanent disability) is so much higher for people with lower educational attainment. A number of studies have pointed to psychological factors as being of primary importance for this transition, for example depressive symptoms and a belief that the pain being experienced will remain permanent (Casey et al., 2008), and these might be associated with education.

Others have pointed to more fundamental differences in brain functioning between chronic pain sufferers and those who recover. Using fMRI scans and other approaches, neuroscientists have argued that chronic back pain (CBP) is associated with fundamental chemical changes in the brain that leads to heightened activity in the medial prefrontal cortex (along with a decline in gray matter density in other parts of the prefrontal cortex), with these factors accounting for roughly three-quarters of the variation in the intensity and duration of chronic back pain (Balaki, et al., 2006). That areas of the brain affected by chronic pain are also regions associated with emotion and memory is particularly intriguing. While there is some suggestive evidence suggesting that brain structure differs by socioeconomic status (see

Hackman and Farah, 2009), the differences do not appear to be sufficiently consistent and large to explain the results we find in the data.

Perhaps a more fruitful explanation for the observed socioeconomic differences in pain is the idea that it is affected by social norms or economic factors, perhaps drawing on the insight that regions of the brain affected by pain are also associated with emotion. Gawande (2002) recounted the "epidemic" of repetition strain injury (RSI) in Australia during the 1980s:

> This was not a mild case of writer's cramp but a matter of severe pain, which started with minor discomfort during typing or other repetitive work and progressed to invalidism. The average time that a sufferer lost from work was seventy-four days. As with chronic back pain, no consistent physical abnormality or effective treatment could be found, yet the arm pain spread like a contagion. (p. 128)

There were widespread outbreaks of this syndrome, with some factories or states being affected in large numbers and others passed by. However, by 1987, the epidemic was over, with observers viewing the most important reasons being that the syndrome was out of favor with physicians, and that it became harder to receive disability payments because of the RSI. While the evidence presented here is suggestive rather than definitive, it does raise questions about the interaction between the Social Security Disability Insurance (SSDI) program, the perception of pain, and social norms. Indeed, Hadler, Tait, and Chibnall (2007) have proposed that chronic back pain often evolves in response to the strong incentives inherent in the U.S. workers' compensation system, while Gawande's description of the Australian RSI epidemic is explicit in pointing to a social contagion model along the lines of Glaeser, Scheinkman, and Sacerdote (1996, 2003) or Rege et al. (2008).

This paper is just a first step in trying to better understand the economic and social implications of pain. Our ongoing research is focusing on changes over time in the prevalence of pain and how these trends may be associated with social programs such as the SSDI program. The evidence from this paper suggests that we need to better understand why low educational attainment translates into something more than the risk of a dead-end job -- the risk also of a life ruined by chronic long-term pain.

Appendix: The Roland-Morris Questionnaire

1. I stay at home most of the time because of my back
2. I change position frequently to try and get my back comfortable
3. I walk more slowly than usual because of my back
4. Because of my back I am not doing any of the jobs that I usually do around the house
5. Because of my back, I use a handrail to get upstairs
6. Because of my back, I have to hold on to something to get out of an easy chair
7. I get dressed more slowly than usual because of my back
8. I only stand up for short periods of time because of my back
9. Because of my back, I try not to bend or kneel down
10. I find it difficult to get out of a chair because of my back
11. My back is painful almost all the time
12. I find it difficult to turn over in bed because of my back
13. I have trouble putting on my sock (or stockings) because of the pain in my back
14. I only walk short distances because of my back pain
15. I sleep less well because of my back
16. I avoid heavy jobs around the house because of my back
17. Because of my back pain, I am more irritable and bad tempered with people than usual
18. Because of my back, I go upstairs more slowly than usual
19. I stay in bed most of the time because of my back
20. Because of my back problem, my sexual activity is decreased
21. I keep rubbing or holding areas of my body that hurt or are uncomfortable
22. Because of my back, I am doing less of the daily work around the house than I would usually do
23. I often express concern to other people about what might be happening to my health

Source: Trout, et. al. (2005).

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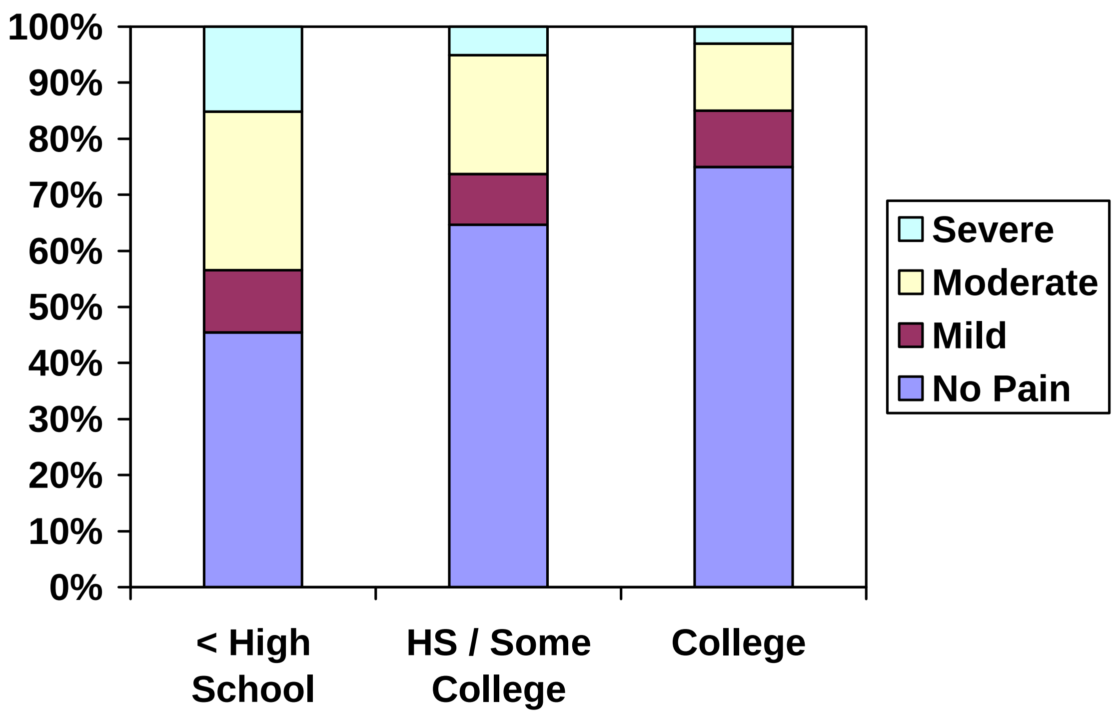
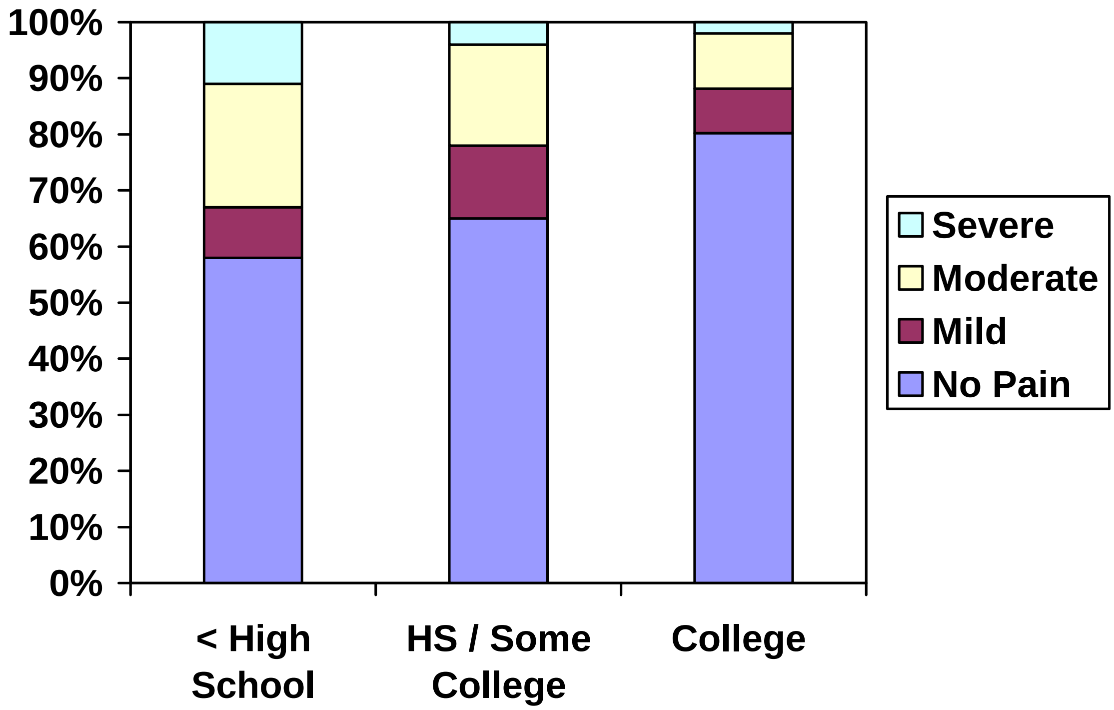
Figure 1a: Rates of Pain by Education Group: Females, 2004



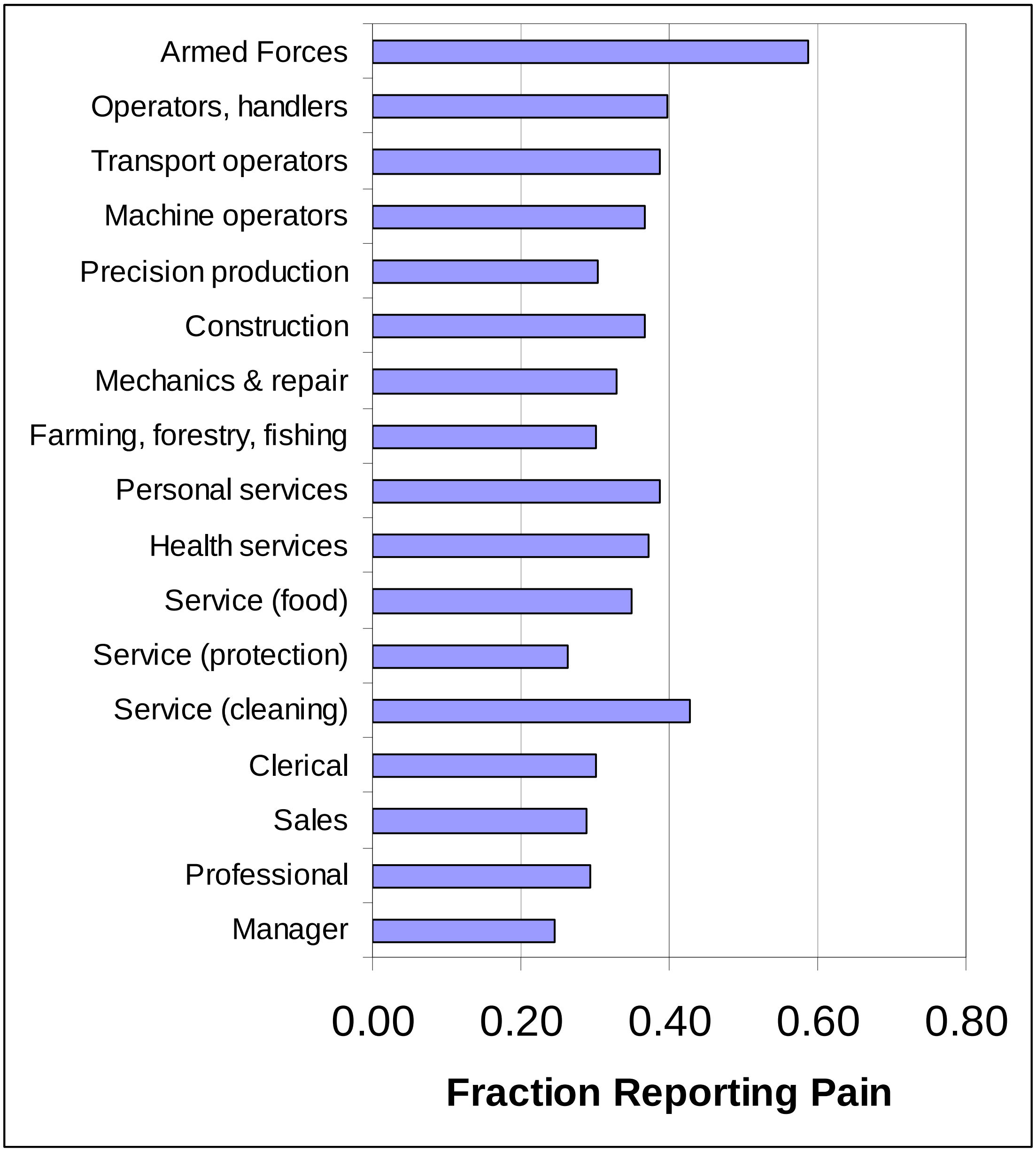
Source: Health and Retirement Study, 2004, Ages 50-59 (N = 2772).

Figure 1b: Rates of Pain by Education Group: Males, 2004



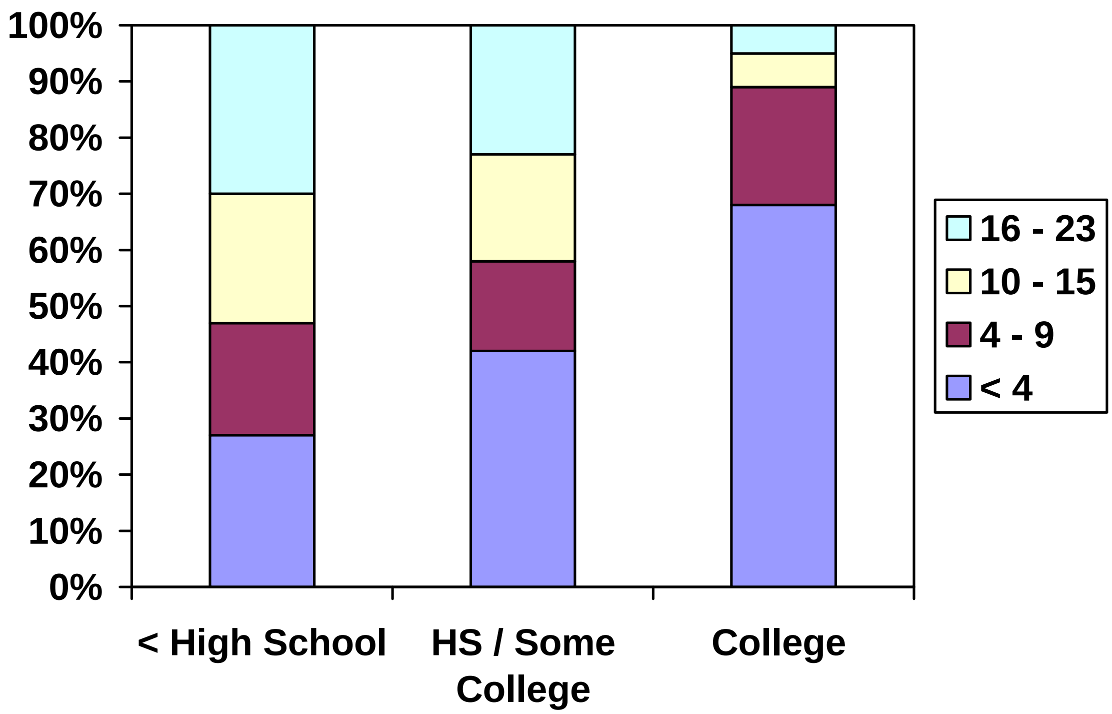
Source: Health and Retirement Study, 2004, ages 50-59 (N = 1951).

Figure 2: Fraction Reporting Pain by Occupation in the HRS: 2004



Note: Age 50-59, adjusting for education, marital status, race, weight, and industry; based on Column 4 in Table 2. See the HRS Codebook for the complete definitions of occupation.

Figure 3: Rowland-Morris Score Ten Years After Baseline: by Education



Notes: A Roland-Morris score of 23 is the most severe, 0 the least severe. See Appendix for details of the questions.

Table 1: The Prevalence of Pain, by Education and Age

Age	High School Dropouts	High School Graduates +	College Graduates +	Sample Size
Females				
50-59	55.12	35.72	25.39	2,776
60-69	44.04	36.60	28.63	3,588
70-79	38.15	34.15	30.14	2,518
80-89	33.23	33.33	30.00	1,430
90+	36.65	33.44	32.95	249
Sample Size	2,644	6,105	1,812	10,561
Males				
50-59	42.20	35.15	19.40	1,956
60-69	40.85	31.36	22.30	2,828
70-79	28.51	26.84	21.06	2,061
80-89	28.64	31.10	27.65	883
90+	27.34	36.91	23.14	119
Sample Size	1,976	3,841	2,030	7,847

Source: Health and Retirement Study, 2004.

Table 2: Regression Analysis Explaining Prevalence of Pain: Health and Retirement Study, 2004

	(1)	(2)	(3)	(4)	(5)
Age Groups	**50-59**	**60-69**	**70-79**	**50-59**	**60-69**
HS Graduate	-0.133	-0.093	-0.042	-0.096	-0.078
	(5.45)**	(5.22)**	(2.38)*	(3.52)**	(3.94)**
College +	-0.252	-0.172	-0.085	-0.168	-0.157
	(9.72)**	(8.24)**	(3.94)**	(5.38)**	(6.04)**
Black	-0.047	-0.080	-0.044	-0.069	-0.093
	(2.20)*	(4.05)**	(1.76)	(3.05)**	(4.60)**
Other Race/Ethnicity	0.019	0.009	-0.042	0.011	0.001
	(0.64)	(0.23)	(1.14)	(0.36)	(0.04)
Sex	0.093	0.111	0.138	0.129	0.107
	(5.45)**	(7.02)**	(7.80)**	(6.66)**	(5.59)**
Divorced	0.158	0.087	-0.024	0.163	0.064
	(3.34)**	(1.53)	(0.31)	(3.23)**	(1.07)
Widowed	0.042	0.008	0.050	0.023	0.001
	(2.00)*	(0.35)	(1.69)	(1.10)	(0.06)
Separated	-0.004	-0.038	-0.020	-0.018	-0.059
	(0.10)	(1.76)	(1.08)	(0.48)	(2.62)**
Never Married	0.019	-0.060	-0.047	0.007	-0.070
	(0.57)	(1.67)	(1.09)	(0.21)	(1.88)
Log (weight) in lbs	-3.350	-3.321	-4.246	-3.583	-3.108
	(3.33)**	(3.33)**	(3.53)**	(3.43)**	(3.06)**
Log $(weight)^2$	0.352	0.352	0.442	0.373	0.333
	(3.63)**	(3.66)**	(3.76)**	(3.71)**	(3.39)**
Age 55-59	0.030			0.034	
	(2.00)*			(2.22)*	
Age 65-69		-0.034			-0.033
		(2.53)*			(2.39)*
Age 75-79			-0.012		
			(0.79)		
Constant	8.290	8.137	10.425	8.861	7.455
	(3.17)**	(3.15)**	(3.39)**	(3.27)**	(2.83)**
Industry & Occupation Dummy Variables	NO	NO	NO	YES	YES
Observations	4617	6290	4533	4354	5880
R-squared	0.06	0.05	0.03	0.08	0.06

Robust t-statistics in parentheses. * significant at 5%; ** significant at 1%

Table 3: Ordered Probits Explaining the Intensity of Pain: Health and Retirement Study, 2004

	(1)	(2)	(3)
Age Groups	**50-59**	**60-69**	**70-79**
HS Graduate	-0.310	-0.248	-0.135
	(4.63)**	(4.95)**	(2.39)*
College +	-0.542	-0.498	-0.227
	(6.46)**	(7.05)**	(2.76)**
Black	-0.116	-0.245	-0.108
	(1.79)	(4.20)**	(1.39)
Other Race/Ethnicity	0.069	0.068	-0.143
	(0.80)	(0.54)	(1.03)
Sex	0.398	0.307	0.399
	(7.34)**	(6.00)**	(6.09)**
Divorced	0.492	0.204	-0.081
	(3.81)**	(1.28)	(0.30)
Widowed	0.098	0.059	0.121
	(1.74)	(0.99)	(1.50)
Separated	-0.010	-0.136	-0.040
	(0.10)	(2.13)*	(0.66)
Never Married	0.046	-0.221	-0.062
	(0.47)	(1.97)*	(0.43)
Log (weight) in lbs	-9.170	-9.258	-6.905
	(3.29)**	(3.37)**	(2.05)*
Log $(\text{weight})^2$	0.946	0.975	0.747
	(3.55)**	(3.69)**	(2.28)*
Age 55-59	0.109		
	(2.58)**		
Age 65-69		-0.062	
		(1.66)	
AGe 75-79			-0.079
			(1.70)
Industry & Occupation Dummy Variables	YES	YES	YES
Cut Point 1 (mild)	-21.45	-21.25	-15.40
Cut Point 2 (moderate)	-21.11	-20.96	-15.14
Cut Point 3 (severe)	-20.12	-20.02	-14.22
Observations	4346	5874	3852

Notes: Robust z statistics in parentheses. * significant at 5%; ** significant at 1%

Table 4: Summary Statistics for Maine IDH Study: By Education

Variable (Baseline unless noted)	Less Than High School	High School Graduates +	College Graduates	Entire Sample
Average Age	42.6	38.70	42.87	40.37
	(13.7)	(9.24)	(10.0)	(10.2)
Sex (Female = 1)	0.149	0.325	0.390	0.325
	(0.36)	(0.47)	(0.49)	(0.47)
Quebec Severity Score (1 = Evidenc)	0.565	0.567	0.658	0.593
	(0.50)	(0.50)	(0.48)	(0.49)
Fraction Severe Imaging Score	0.021	0.108	0.154	0.112
	(0.15)	(0.31)	(0.36)	(0.32)
Fraction Missing Imaging Score	0.447	0.522	0.520	0.513
	(0.50)	(0.50)	(0.50)	(0.50)
Smoker	0.574	0.510	0.287	0.452
	(0.50)	(0.50)	(0.45)	(0.50)
Neurological Weakness (Score of 0 through 4)	1.370	1.300	1.197	1.277
	(0.80)	(1.00)	(0.96)	(0.96)
Comorbidities*	0.277	0.181	0.285	0.222
	(0.45)	(0.39)	(0.45)	(0.42)
Roland-Morris Score (Average at Baseline)	16.83	16.33	14.55	15.86
	(4.89)	(5.13)	(5.65)	(5.32)
Fraction Pain Always or Almost Always (Baseline)	0.787	0.787	0.732	0.771
	(0.41)	(0.41)	(0.44)	(0.42)
SF36 Bodily Pain Score (Scale of 1 to 100)	21.91	24.07	30.37	25.69
	(20.18)	(18.54)	(24.00)	(20.66)
SF36 Physical Function Score (Scale of 1 to 100)	29.67	36.20	44.70	38.03
	(23.49)	(25.59)	(28.71)	(26.72)
Fraction Died in 10 year period	0.06	0.03	0.03	0.03
	(0.25)	(0.17)	(0.18)	(0.18)
Fraction Surgical Treatment	0.404	0.402	0.350	0.387
	(0.50)	(0.49)	(0.48)	(0.49)
Prescription Narcotics	0.426	0.474	0.504	0.477
	(0.50)	(0.50)	(0.50)	(0.50)
Roland-Morris Score (10-Year Follow-up)	10.83	7.99	3.40	6.72
	(7.88)	(7.37)	(4.65)	(7.08)
Fraction Pain Always or Almost Always (10-Year Follow-up)	0.343	0.196	0.088	0.176
	(0.48)	(0.40)	(0.29)	(0.38)
Sample Size at Baseline	47	249	122	419
Sample Size at 10-Year Follow-up	35	204	113	352

Notes: * Comorbidities include pulmonary disorders, cardiac problems, stroke, cancer or diabetes. Standard deviation in parentheses.

Table 5: Regression Coefficients Explaining the Endpoint Roland-Morris Score and Severe Pain Measure in the Maine Lumbar Spine Study

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Roland	Roland	Roland	Pain	Pain
Independent Variables					
HS Education	-2.686	-1.715	-1.173	-0.136	-0.043
	(1.98)*	(1.29)	(0.86)	(1.92)	(0.58)
College Graduate	-7.340	-5.833	-5.239	-0.244	-0.133
	(5.24)**	(4.21)**	(3.70)**	(3.29)**	(1.69)
Sex	0.049	-0.210	-0.231	-0.033	-0.053
	(0.06)	(0.27)	(0.29)	(0.77)	(1.24)
Age 30-39	-2.326	-1.275	-1.473	-0.015	-0.013
	(1.84)	(1.02)	(1.17)	(0.24)	(0.20)
Age 40-49	-1.232	-0.229	-0.768	0.039	0.038
	(0.94)	(0.18)	(0.60)	(0.59)	(0.56)
Age 50-59	-3.829	-2.992	-3.328	-0.078	-0.079
	(2.52)*	(1.99)*	(2.22)*	(1.00)	(0.98)
Age 60+	-1.961	-0.533	-0.642	-0.015	0.022
	(0.91)	(0.25)	(0.30)	(0.13)	(0.19)
Quebec Imaging Score		2.376	2.188		-0.019
		(0.64)	(0.59)		(0.09)
Severe Imaging Score		-1.480	-1.250		-0.039
		(1.26)	(1.06)		(0.59)
Smoker (1 = yes)		2.259	2.112		0.112
		(2.83)**	(2.64)**		(2.59)**
Neuro. weakness = 1		-0.574	-0.202		0.075
		(0.58)	(0.20)		(1.36)
Neuro. weakness = 2		-0.255	-0.424		-0.060
		(0.07)	(0.11)		(0.28)
Neuro. weakness = 3		0.039	0.004		0.016
		(0.01)	(0.00)		(0.07)
Comorbidities*		2.714	2.979		0.145
		(3.11)**	(3.37)**		(2.96)**
Baseline Roland		0.243	0.101		-0.006
		(3.25)**	(0.80)		(0.83)
Baseline pain			1.133		0.031
			(1.09)		(0.53)
Baseline BF36			-0.025		-0.001
			(0.94)		(0.81)
Baseline PF36			-0.020		-0.001
			(0.95)		(0.92)
Surgery (1 = yes)			1.412		-0.052
			(1.69)		(1.13)
Baseline narcotics			-0.399		-0.000
			(0.48)		(0.01)
Constant	12.630	7.091	9.630	0.349	0.493
	(7.69)**	(1.62)	(1.88)	(4.29)**	(1.68)
Observations	301	293	288	348	332
R-squared	0.15	0.25	0.28	0.05	0.11

Notes: t-statistics in parentheses. * significant at 5%; ** significant at 1%.