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Original article

The impact of pain on labor force participation, absenteeism and presenteeism in the European Union

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Abstract

Objectives:
The aims of this paper are to generate estimates of the association between the experience and burden of pain, by severity and frequency, with (1) labor force participation and workforce status in five EU countries (the UK, France, Spain, Germany and Italy) and (2) patterns of absenteeism and presenteeism for the employed workforce.

Methods:
Data are from the internet-based 2008 National Health and Wellness Survey (NHWS). This survey covers both those who report experiencing pain in the last month as well as the no pain population. A series of regression models are developed with the no pain group as the reference category. The impact of pain, categorized by severity and frequency reported, is assessed within a labor supply framework for (1) labor force participation and (2) absenteeism and presenteeism. In the former case both binomial and multinomial logistic models are estimated; in the latter case ordered logit models are estimated.

Results:
The results demonstrate that, in the context of health status, the experience of frequent severe and moderate pain has a dominant, independent and negative association with labor force participation and employment status as well as absenteeism and presenteeism. The presence of severe daily pain is associated with a 20-point reduction in the probability of being employed full-time; with moderate daily pain associated with a 10-point reduction. The impact of pain is far greater than the potential impact of other health status measures (e.g., chronic comorbidities and BMI). The experience of pain, notably severe and frequent pain, also outstrips the impact of other health status factors in absenteeism and presenteeism.

Conclusions:
The experience of pain, in particular severe daily pain, has a substantial negative association with labor force participation in these five European countries as well as reported absenteeism and presenteeism. As a measure of health status, it clearly outweighs other health status measures. Whether or not pain is considered as a disease in its own right, the experience of chronic pain, as defined here, presents policy makers with a major challenge. Programs to relieve the burden of pain in the community clearly have the potential for substantial benefits from societal, individual and employer perspectives.

Introduction

Health status is seen as a major predictor of labor supply. In the human capital framework of labor supply there are theoretical reasons for predicting that deteriorating health and the presence of chronic disease and associated comorbidities, together with symptoms such as severe and frequent pain, will be associated with reduced labor supply[1]. This would be expected to be seen both in the

decision to participate in the labor force as well as in a higher incidence of absenteeism and presenteeism. The empirical evidence strongly supports these expectations. To the extent that the experience of pain negatively impacts labor force participation, as well as increasing absenteeism and presenteeism experience, this imposes not only a burden on society in terms of output foregone, but a commensurate burden on employers and income foregone to individuals and their families. At the same time, it adds to the overall costs of healthcare and the costs of disability support.

The impact of chronic health conditions, associated disabilities and the presence of pain-specific conditions on labor force status, absenteeism and presenteeism are well-established. While the majority of these studies have looked at claims for general health status and labor market outcomes, a particular focus has been on health risk factors such as obesity, smoking and alcohol use, although specific chronic disease states such as diabetes have been evaluated together with disease states or conditions associated with chronic pain such as depression[2–4] . Chronic low back pain has been examined extensively in terms of both its correlates with employment activity as well as attempts to establish predictors of absenteeism and reduced labor force participation[5]. In the US workforce a range of common pain conditions have been shown to impact productive time[4]. Pain has been shown in small-scale employer studies to impact physical and mental health, to limit work performance and increase absenteeism and presenteeism[6]. In respondents with chronic pain, psychosocial problems such as substance abuse, mood disorders, employment handicaps and poor coping skills are common[7]. Importantly, chronic and recurrent pain is now considered by many to be a disease in its own right and not merely a symptom. Pain is no longer seen as related to an evolving injury but as reflecting pathophysiological changes within the nociceptive system with psychosocial responses that perpetuate the problem[8].

Even with this evidence for the relationship between self-reported general health status, chronic health conditions and pain and labor market outcomes, there are still some major gaps in our understanding of the independent impact of pain. Unlike countries such as the United States and Australia, there are few estimates in Europe of the national impact of the severity and frequency of pain on labor force participation, absenteeism and presenteeism. Noteworthy are the Grampian community study by Smith *et al.*[9] and a recent study of widespread pain and work status in Sweden[10]. More comprehensive studies which have assessed pain across the EU have been limited in their ability to assess employment and related impacts by the absence of a no pain reference group[11].

The aim of this study is to attempt to fill this gap by providing an evaluation of (1) the contribution of pain severity and frequency to reduced labor force participation in five EU countries (the UK, France, Spain, Italy and Germany), and (2) the contribution of pain severity and frequency to increased rates of absenteeism and presenteeism for those in employment.

Methods

It is not the purpose of the present analysis to differentiate pain by pain type. While it would be possible to undertake such an analysis with the data to hand (e.g., differentiating nociceptive as opposed to neuropathic pain) the focus is on the burden of pain experienced by individuals and the community. This is achieved by taking as the reference group the 'no pain' population. Pain is considered to be exogenous for the purpose of this analysis, although it is recognized that there may be an argument for endogeneity where the experience of pain may be an outcome of prior workforce decisions (e.g., occupational choice), the presence of chronic disease (and associated risk factors) or unobserved individual or household characteristics. Even so, evidence for the impact of endogeneity is mixed[12,13]. In the present case experience of chronic disease and its contribution to the experience of pain is only considered through the presence of comorbidities as a potential confounding characteristic, recognizing that there are pain conditions such as fibromyalgia which appear unrelated to any underlying disease etiology.

National Health and Wellness Survey

The National Health and Wellness Survey (NHWS) is a syndicated, annual and biannual, internet-based, cross-sectional study of the healthcare attitudes, behaviors, and characteristics of the adult population. It is undertaken in the US, UK, France, Spain, Germany Italy, urban China and Japan. Since its initiation in 1998, over 600,000 survey responses across approximately 140 conditions have been collected. In addition, several supplementary studies have been conducted in which NHWS respondents were re-contacted and asked further questions. The present analysis is based on the results of the 2008 NHWS for these five EU countries. A total of 53,524 persons 18 years of age and over were interviewed, yielding an age/gender weighted or estimated overall population of 247.3 million.

Screening questions

All respondents to the 2008 NHWS were asked if they had experienced pain in the last month and the condition(s) that had caused pain. If respondents indicated that they had only experienced menstrual pain, migraine, dental pain or headache in the last month, they were excluded from the pain category. Respondents were then asked

about the severity of pain reported and the frequency with which they had problems with pain in the past 30 days. Respondents who reported severity but not the frequency of pain were excluded from the analysis. These results are summarized in Table 1. Overall, of those reporting both the severity and frequency of pain, 59.2% (29.4 million) reported moderate pain, 22.8% reported mild pain and 18.0% severe pain. A total of 43.6% reported experiencing pain in last month on a daily basis, with 29.2% experiencing pain 2–6 times a week. Combining severity with frequency, the largest category is for persons reporting daily moderate pain 11.7 million (23.6%) with 8.5 million (17.1%) reporting severe, daily pain.

Dependent variables

All respondents to the 2008 NHWS were asked to report their labor force status and to complete the Workplace Productivity and Activity Impairment Scale (WPAI) to measure the impact of health status on employment related activities. The WPAI questionnaire measures work time missed and work and activity impairment because of a specified health problem during the past 7 days[14]. The validity and accuracy of the instrument has been established in a number of disease states (e.g., irritable bowel syndrome, asthma, dermatitis, Crohn's disease)[15,16].

Table 1. Reported pain severity and frequency of pain.

Pain dimension	Respondents five EU countries*	Distribution (%)
Pain level		
Severe	11,318,103	22.8
Moderate	29,439,982	59.2
Mild	8,970,445	18.0
Pain frequency		
Daily	21,703,485	43.6
2–6 times a week	14,510,928	29.2
Weekly or less	13,514,117	27.2
Pain level and frequency		
Severe daily pain	8,506,068	17.1
Severe and 4–6 times per week	969,348	2.0
Severe and 2–3 times per week	734,408	1.5
Severe and weekly or less	1,108,279	2.2
Moderate daily pain	11,746,535	23.6
Moderate and 4–6 times a week	4,145,306	8.3
Moderate and 2–3 times per week	6,047,471	12.2
Moderate and weekly or less	7,500,670	15.1
Mild daily pain	1,450,882	2.9
Mild and 2–6 times per week	2,614,395	5.3
Mild and weekly or less	4,905,168	9.9

*UK, France, Spain, Germany, Italy.
Source: National Health and Wellness Survey 2008.

Labor force status

The NHWS asks respondents to report on their current workforce status in terms of (1) employment status – full-time, part-time, self-employed, (2) unemployment status – actively looking for work, and (3) not in the labor force. The distribution of respondents by workforce status is shown in Table 2. The striking feature of this table is the impact of the pain on full-time employment status. Overall, 34.85% persons experiencing pain are employed full-time compared to 44.52% of those in the no pain category. The converse applies to those not in the labor force (44.07 vs. 35.54). The increasing severity of pain has a marked impact. Among those reporting severe pain only 25.98% are employed full-time with 55.33% not in the labor force.

Absenteeism and presenteeism

The WPAI absenteeism and workplace questions are only relevant to those in employment – where the NHWS identifies persons who are currently employed full-time, employed part-time or self-employed. Respondents are asked to indicate:

- During the past 7 days, how many hours did you miss from work because of your health problems? (Range 0 to 112 hours)
- During the past 7 days, how many hours did you miss from work because of any other reason such as vacation, holidays, time off to participate in this study? (Range 0 to 112 hours)
- During the past 7 days, how many hours did you actually work? (Range 0 to 112 hours)
- During the past 7 days how much did your health problems affect your productivity while you were working? (Response on a 0 – 10 scale from 'health problems had

Table 2. Labor force status of persons reporting pain by pain severity and no pain.

Labor force status	Persons reporting no pain (%)	Persons reporting pain (%)	Persons reporting mild pain (%)	Persons reporting moderate pain (%)	Persons reporting severe pain (%)
Employed full-time	44.52	34.85	47.39	34.44	25.98
Employed part-time	6.11	5.56	7.25	5.72	3.79
Self-employed	9.80	10.58	10.75	10.83	9.81
Unemployed	4.03	4.93	4.05	5.15	5.08
Not in labor force	35.54	44.07	30.56	43.86	55.33
Total	100.00	100.00	100.00	100.00	100.00

Source: National Health and Wellness Survey 2008.

Table 3. Workplace productivity and activity impairment scale: impact of health problems on absenteeism in the past 7 days.

Absenteeism: percentage of worktime lost	All persons (%)	Persons reporting 'no pain' (%)	Persons reporting 'pain' (%)
0–9 (Health problems had no effect on my work)	90.15	91.90	82.15
10–19	2.28	1.90	4.02
20–29	1.69	1.35	3.27
30–39	0.63	0.51	1.19
40–49	0.62	0.51	1.13
50–59	1.26	1.28	1.18
60–69	0.45	0.37	0.82
70–79	0.23	0.22	0.28
80–89	0.15	0.14	0.19
90–99	0.11	0.09	0.18
Health problems completely prevented me from working	2.41	1.72	5.58

Source: National Health and Wellness Survey, 2008.

Table 4. Workplace productivity and activity impairment scale: impact of health problems on presenteeism in the past 7 days.

Presenteeism responses	All persons (%)	Persons reporting 'no pain' (%)	Persons reporting 'pain' (%)
0 (Health problems had no effect on my work)	52.03	56.22	32.08
1	12.94	12.95	12.84
2	10.13	9.39	13.66
3	6.66	5.90	10.27
4	3.92	3.38	6.52
5	5.51	4.97	8.09
6	4.06	3.53	6.58
7	2.73	2.04	5.99
8	0.97	0.71	2.21
9	0.41	0.36	0.66
10 (Health problems completely prevented me from working)	0.63	0.53	1.10

Source: National Health and Wellness Survey, 2008.

no effect on work' to 'health problems completely prevented me from working)

- During the past 7 days, how much did your health problems affect your ability to do your regular daily activities, other than work at a job? (Response on a 0–10 scale from 'health problems had no effect on my daily activities' to 'health problems completely prevented me from doing my daily activities)

Two measures of employment impact are generated from these responses. These are:

(1) Absenteeism: percentage of work time missed in the past 7 days
(2) Presenteeism: percentage of worktime in which work was impaired

For the purpose of the present analysis, the absenteeism responses are put on the same basis as the presenteeism responses. That is, they are translated into the percentage of total non-work time and presented as class intervals from 0 to 9% of time lost to 100% of time lost.

The distribution of days lost due to absenteeism as a result of ill-health are presented in Table 3. An estimated 9.85% of employed persons reported days lost due to ill-health to absenteeism overall. Of those experiencing pain, the figure is 17.85% compared to 8.10% of those in the no pain category.

Presenteeism also varies by whether pain is or is not experienced. Among the pain population 67.92% reported limitations on their productivity while they were working compared to 43.78% of the no pain population.

Independent variables

The choice of independent variables reflects their anticipated impact on labor supply decisions – as these impact both labor force status as well as absenteeism and presenteeism. The variables are considered under the following heads:

- Socio-demographic variables
- Country of residence
- Health risk behaviors
- Comorbidity status

Within a life-cycle model of labor supply, the interaction of age, gender and education on labor force participation is well-established. Labor force participation is expected to

Table 5. Distribution of independent variables.

Independent variables	No pain (%)	Pain (%)
Socio-demographic variables		
Age: 20–39 years	38.0	28.9
Age: 4–59 years	35.2	41.7
Age: 60 years and older	26.8	29.4
Gender: male	50.9	39.4
Gender: female	49.1	60.7
Education: university or higher	32.1	25.1
Education: high school completed	50.7	49.2
Education: other	17.2	25.7
Income: under €20,000	25.6	33.1
Income: €20,000–39,999	35.0	34.0
Income: €40,000 and above	23.3	18.5
Income reporting declined	16.1	14.5
Health risk behaviors		
BMI: underweight	2.6	2.3
BMI: normal weight	39.9	31.3
BMI: overweight	37.3	35.8
BMI: obese	16.3	24.1
BMI: morbidly obese	1.6	4.5
BMI: reporting declined	2.2	2.0
Current smoker	28.5	32.8
Alcohol user	60.4	54.8
Morbidity/comorbidity status		
Charlson Comorbidity Index (SD)	0.301 (0.903)	0.603 (1.252)

SD, standard deviation.
Source: National Health and Wellness Survey, 2008.

increase with education, but decline with age reflecting both the impact of poorer health on workforce decisions, the impact of wealth accumulation on household decisions, as well as institutional factors determining retirement status. Absenteeism and presenteeism would also be expected to increase with age – again reflecting the impact of poorer health. To the extent that pain is associated with characteristics such as age, gender and education, these would be expected to have a negative impact. In this context it is of interest to note (1) the percentage of females reporting pain (60.7%) is substantially greater than for males (39.3%), and (2) persons with a university or higher education have a lower prevalence of pain than those who have not completed high school. The higher reported prevalence of chronic pain among females is well-documented with females at a higher risk of developing several chronic pain disorders[17,18]. The association of pain and educational level is also well-documented. Blythe *et al.*[19] report on pain being significantly associated with lower levels of completed education in Australia, while Callahan and Pincus[20] find that poorer clinical status in rheumatoid arthritis is associated with lower levels of educational attainment. More respondents in the pain group report household income less than €30,000 (and fewer with income greater than €40,000). The income variables are only used in the absenteeism and presenteeism models.

The potential for country-specific effects is captured by including each of the five EU countries in the model as categorical variables (with Germany the reference category). There is no expectation as to either the significance of potential country effects or the direction of change on labor force participation, absenteeism or presenteeism.

Three health risk behaviors are identified: body mass index (BMI), current smoking and current alcohol consumption. The NHWS does not allow a more detailed assessment of actual alcohol consumption or number of cigarettes per day and duration of smoking behavior.

The relationship between BMI and labor force participation, absenteeism and presenteeism is less clear cut. To the extent that BMI is taken as a marker for health status persons reporting a BMI in the range of obesity and morbid obesity would be expected to have a lower participation rate and a higher probability of absenteeism and presenteeism. As far as the other health risk behaviors of smoking and alcohol are concerned, their relationship to labor force participation, absenteeism and presenteeism is most appropriately seen through their potential role as health status markers.

The presence of morbid/comorbid conditions is captured by the Charlson Comorbidity Index (CCI). The CCI was originally designed as a measure of the risk of 1-year mortality attributable to comorbidity in a longitudinal study of general hospitalized patients. It was then validated for the same outcome in a cohort of breast cancer patients. Its contents and weighting scheme were created on the basis of Cox proportional hazards modeling[21]. It was subsequently adapted so that *International Classification of Diseases*, Ninth Revision (ICD-9) codes could be used to calculate the Charlson Comorbidity Index with existing administrative data. The CCI contains 19 categories of comorbidity, which are primarily defined using ICD-9-CM diagnoses codes (a few procedure codes are also employed). Each category has an associated weight, taken from the original Charlson paper, which is based on the adjusted risk of one-year mortality. The overall comorbidity score reflects the cumulative increased likelihood of one-year mortality; the higher the score, the more severe the burden of comorbidity. In this analysis the average CCI in the pain group is almost twice that for the no pain population.

To the extent that the CCI, together with the impact of age, reflects ill health, it is predicted to impact adversely work activity decisions in a number of ways. First, the presence of chronic comorbidities would be expected to increase the disutility of work and workplace productivity. This would be reflected in a reduced willingness to seek work or to remain in the workforce. Second, for those in the workforce the presence of chronic comorbidities would be expected to increase both absenteeism and presenteeism. Third, the possibility of receiving ill-health related disability benefits would further reduce work incentives. Finally, to the extent that poor health indicated reduced life expectancy, this would increase the present value of wealth and encourage early retirement.

Estimation

The impact of pain severity and frequency on labor force participation is estimated (1) through a binary logit model where the dependent variable is whether or not the respondent is in the labor force, and (2) through a multinomial logit model where the unordered dependent variable captures the five labor force and not in the labor force categories. Not being in the labor force is the reference category. The impact of pain on absenteeism and presenteeism is assessed, for those respondents in employment, through the specification of ordered logit models. The dependent variables are (1) the estimated percentage of worktime lost in the last 7 days due to ill health, and (2) the estimated percentage impact on work productivity of ill-health experienced over the last 7 days. All models are estimated: (1) for persons reporting severity of pain (Model I), and (2) persons reporting severity and frequency of pain (Model II). In both cases the no pain respondents are the reference category.

Table 6. Labor force participation logit regressions.

Regression model	Binary logit model I			Binary logit model II		
Independent variables	Odds ratio	$p>\|z\|$	95% confidence interval	Odds ratio	$p>\|z\|$	95% confidence interval
Pain level reported in last month*						
Severe	0.443	0.00	0.399–0.491			
Moderate	0.800	0.00	0.740–0.865			
Mild	1.126	0.10	0.976–1.299			
Pain level and frequency*						
Severe daily pain				0.350	0.00	0.310–0.395
Severe pain and 4–6 times a week				0.678	0.02	0.486–0.945
Severe pain and 2–3 times a week				1.166	0.48	0.758–1.793
Severe pain and weekly or less				0.839	0.27	0.615–1.144
Moderate daily pain				0.612	0.00	0.536–0.697
Moderate pain and 4–6 times a week				0.770	0.01	0.637–0.931
Moderate pain and 2–3 times week				0.918	0.25	0.794–1.062
Moderate pain and weekly or less				1.069	0.34	0.933–1.225
Mild daily pain				0.918	0.66	0.627–1.346
Mild pain and 2–6 times a week				1.326	0.06	0.992–1.772
Mild pain and weekly or less				1.097	0.28	0.926–1.299
Socio-demographic variables						
Age: 40–59 years[1]	1.355	0.00	1.281–1.432	1.388	0.00	1.312–1.468
Age: 60 years and older[1]	0.053	0.00	0.049–0.058	0.055	0.00	0.050–0.059
Gender: male[2]	1.652	0.00	1.561–1.748	1.651	0.00	1.560–1.747
Education: high school completed[3]	0.922	0.03	0.856–0.994	0.923	0.03	0.856–0.994
Education: university or higher[3]	1.857	0.00	1.714–2.011	1.861	0.00	1.718–2.015
Country: UK[5]	0.721	0.00	0.671–0.775	0.731	0.00	0.680–0.787
Country: France[5]	0.726	0.00	0.681–0.775	0.729	0.00	0.684–0.779
Country: Spain[5]	1.096	0.12	0.977–1.230	1.105	0.09	0.985–1.240
Country: Italy[5]	1.278	0.00	1.156–1.412	1.278	0.00	1.157–1.413
Health risk behaviors						
BMI: underweight[6]	0.766	0.00	0.661–0.886	0.763	0.00	0.659–0.884
BMI: overweight[6]	1.123	0.00	1.053–1.198	1.125	0.00	1.055–1.201
BMI: obese[6]	1.061	0.12	0.986–1.143	1.070	0.08	0.993–1.152
BMI: morbidly obese[6]	0.816	0.01	0.706–0.944	0.836	0.02	0.722–0.967
BMI: reporting declined	0.841	0.02	0.730–0.968	0.842	0.02	0.731–0.970
Current smoker[7]	1.340	0.00	1.264–1.420	1.338	0.00	1.262–1.418
Alcohol user[8]	1.349	0.00	1.277–1.426	1.344	0.00	1.271–1.420
Morbidity/comorbidity status						
Charlson Comorbidity Index	0.922	0.00	0.890–0.954	0.925	0.00	0.895–0.957
n	53,052			53,052		
Log pseudo likelihood	−27,964.5			−27896.7		
Pseudo R^2	0.297			0.299		

Reference categories: *no pain reported in last month; [1]age 18–39 years; [2]females; [3]not completed high school; [4]income under €20,000; [5]country: Germany; [6]BMI normal weight; [7]non-smoker; [8]non-drinker.

Results

Results for the binary logistic labor force participation model are presented in Table 6 and the multinomial logistic model in Table 7. The same set of independent variables is utilized in each model. In the latter case the results are presented only for the predicted labor force category outcomes for those reporting severe and moderate pain and those reporting severe daily and moderate daily pain*.

Logistic regression results

In Model I, the more severe pain reported, the greater the negative association with labor force participation (odds rate severe pain 0.443; 95% CI 0.399–0.491). Once severity and frequency of pain are combined the association is more dramatic (Model II). The association with labor force participation is greatest for those experiencing severe daily pain (odds ratio 0.350; 95% CI: 0.310–0.395). Daily moderate pain also has a substantial negative association (odds ratio 0.612; 95% CI: 0.536–0.697). The less severe pain reported and the less frequent, the less dramatic the association with mild pain is not significant at the 5% level.

The presence of chronic comorbidities on labor force participation, while significant at the 5% level, have a less robust relationship than severe or moderate pain. In Model I, the CCI enters with an odds ratio of 0.922 (95% CI: 0.890–0.954). With the BMI reference category of normal weight, BMI only has a negative association with labor force participation for those who are underweight or morbidly obese. Being overweight, together with smoking and

*The complete set of multinomial logit results are available on request.

Table 7. Labor force participation multinomial logit regression: predicted relative probabilities for severe and moderate daily pain.

Labor force status	Multinomial logit model I			Multinomial logit model II	
	Severe pain	Moderate pain	Mild pain	Severe daily pain	Moderate daily pain
Employed full-time					
Pain	0.266	0.368	0.421	0.228	0.316
No pain	0.427	0.426	0.418	0.426	0.424
Employed part-time					
Pain	0.043	0.065	0.077	0.035	0.054
No pain	0.068	0.066	0.066	0.068	0.067
Self-employed					
Pain	0.090	0.105	0.119	0.081	0.099
No pain	0.109	0.108	0.108	0.109	0.109
Unemployed					
Pain	0.038	0.044	0.037	0.035	0.044
No pain	0.038	0.038	0.038	0.038	0.038
Not in the labor force					
Pain	0.564	0.418	0.345	0.621	0.486
No pain	0.359	0.362	0.370	0.359	0.363

alcohol use, have a significant yet positive association with labor force participation.

Age has a substantive negative association with labor force participation for those 60 years of age and over in both models, with males associated with a higher labor force participation rate than females. Higher educational attainment is associated with increased labor force participation.

Although not explored in more detail at the individual country level, place of residence appears to exert an independent effect on labor force participation over and above socio-demographic characteristics, health risk factors and health status. Compared to Germany, the UK and France report lower levels of labor force participation (Model II: UK odds ratio 0.732; 95% CI 0.680–0.787; France: odds ratio 0.729; 95% CI 0.684–0.779). Spain is not significantly different while Italy reports a higher labor force participation.

Multinomial logit regression results

Rather than attempt to present the full results for the multinomial model, summary results are presented for labor force status probabilities (Table 7). For persons reporting severe pain the predicted probability of being in full-time employment is 0.266 compared to an estimated 0.427 for those not experiencing pain. Conversely, the predicted probability of not being in the labor force is 0.564 for those experiencing severe pain compared to 0.359 for those without pain. The association with pain declines with reduced severity. For persons experiencing mild pain the probability of not being in the labor force is only marginally higher for those experiencing pain (0.370 vs. 0.345). Once the frequency of pain is factored in the relationship is more marked. For those persons experiencing severe daily pain the probability of being employed full-time is only 0.228; for those with moderate daily pain the probability is somewhat greater at 0.316. Conversely, the probability of not being in the labor force for those experiencing severe daily pain is 0.621 and moderate daily pain 0.486. Predicted probabilities for the other labor force categories show relatively small differences; the relationship between pain frequency and severity is seen primarily in the self-employed labor force category.

Ordered logit regression results

Results for absenteeism and presenteeism are presented in Tables 8 and 9 respectively. In Model I severe pain and in Model II the combination of severe and moderate pain combined with pain frequency dominate the ordered logit results in their positive association with absenteeism (absenteeism increases with pain severity and frequency). In the case of absenteeism, severe pain enters with an odds ratio of 5.979 (95% CI: 5.088–7.025) while severe daily pain enters with an odds ratio of 8.429 (95% CI: 6.936–10.244). Moderate and mild pain experience has a substantially lower contribution.

Odds ratios for the other independent variables for both absenteeism and presenteeism in Model I are less than those reported for moderate and severe pain. The majority of variables enter with a statistically significant (5% level) contribution. The range of socio-demographic variables considered all have a negative association in reducing absenteeism) with odds ratio less than one. Educational attainment is not significant. Health risk behaviors (BMI and smoking) are typically associated (with the exception of being overweight) with increase absenteeism. The presence of chronic comorbidities increases absenteeism (Model I odds ratio 1.240; 95% CI 1.143–1.346; Model II odds ratio 1.232; 95%CI 1.135–1.338).

Table 8. Absenteeism ordered logit regression results.

Regression model	Ordered logit regression: model I			Ordered logit regression: model II		
Independent variables	Odds ratio	$p>\|z\|$	95% confidence interval	Odds ratio	$p>\|z\|$	95% confidence interval
Pain reported in last month*						
Mild	1.349	0.01	(1.073–1.695)			
Moderate	1.901	0.00	(1.682–2.148)			
Severe	5.979	0.00	(5.088–7.025)			
Pain level and frequency*						
Severe daily pain				8.429	0.00	(6.936–10.244)
Severe pain and 4–6 times a week				5.342	0.00	(3.299–8.651)
Severe pain and 2–3 times a week				2.746	0.00	(1.719–4.385)
Severe pain and weekly or less				1.780	0.03	(1.061–2.984)
Moderate daily pain				2.735	0.00	(2.252–3.322)
Moderate pain and 4–6 times a week				2.086	0.00	(1.590–2.736)
Moderate pain and 2–3 times week				1.960	0.00	(1.568–2.448)
Moderate pain and weekly or less				1.140	0.25	(0.913–1.425)
Mild daily pain				1.202	0.54	(0.671–2.153)
Mild pain and 2–6 times a week				1.728	0.01	(1.132–2.637)
Mild pain and weekly or less				1.207	0.20	(0.903–1.614)
Socio-demographic variables						
Age: 40–59 years[1]	0.862	0.00	(0.783–0.949)	0.833	0.00	(0.757–0.918)
Age: 60 years and older[1]	0.702	0.01	(0.549–0.897)	0.663	0.00	(0.518–0.850)
Gender: male[2]	0.893	0.02	(0.812–0.983)	0.898	0.03	(0.816–0.989)
Education: high school completed [3]	0.983	0.82	(0.849–1.139)	0.993	0.92	(0.858–1.149)
Education: university or higher[3]	1.018	0.82	(0.879–1.178)	1.020	0.79	(0.881–1.181)
Income: €20,000–39,999[4]	0.932	0.26	(0.824–1.054)	0.931	0.25	(0.823–1.053)
Income: €40,000 and above[4]	0.972	0.68	(0.852–1.110)	0.981	0.78	(0.859–1.120)
Income: reporting declined[4]	0.653	0.00	(0.550–0.774)	0.648	0.00	(0.546–0.770)
Country: UK[5]	0.801	0.00	(0.703–0.911)	0.782	0.00	(0.686–0.891)
Country: France[5]	0.809	0.00	(0.714–0.917)	0.794	0.00	(0.701–0.900)
Country: Spain[5]	0.832	0.07	(0.685–1.011)	0.821	0.05	(0.676–0.998)
Country: Italy[5]	1.036	0.66	(0.885–1.212)	1.027	0.74	(0.878–1.202)
Health risk behaviors						
BMI: underweight[6]	1.511	0.00	(1.178–1.939)	1.513	0.00	(1.179–1.942)
BMI: overweight[6]	0.960	0.47	(0.861–1.071)	0.958	0.45	(0.859–1.069)
BMI: obese[6]	1.091	0.19	(0.958–1.242)	1.080	0.25	(0.948–1.232)
BMI: morbidly obese[6]	1.545	0.00	(1.161–2.056)	1.530	0.00	(1.146–2.043)
BMI: reporting declined[6]	1.613	0.00	(1.175–2.214)	1.601	0.00	(1.165–2.201)
Current smoker[7]	1.057	0.26	(0.960–1.164)	1.063	0.21	(0.965–1.171)
Alcohol user[8]	0.916	0.07	(0.833–1.007)	0.918	0.08	(0.834–1.010)
Morbidity/comorbidity status						
Charlson Comorbidity Index	1.240	0.00	(1.143–1.346)	1.232	0.00	(1.135–1.338)
Pseudo R^2 (MacFadden)	0.035			0.039		
Log likelihood	−16436.6			−16376.8		
n	29,626			29,626		

Reference categories: *no pain reported in last month; [1]age 18–39 years; [2]females; [3]not completed high school; [4]income under €20,000; [5]country: Germany; [6]BMI normal weight; [7]non-smoker; [8]non-drinker.

The results for presenteeism (Table 9) are similar to those for absenteeism. The odds ratios of all pain severity variables and for variables combining severity and frequency enter with positive and significant odds ratios with severe and frequent pain having the greatest association with increased presenteeism. The association of pain with presenteeism attenuates with declining severity and frequency. The odds ratios for the majority of the socio-demographic variables are significant. Education is only significant with a positive impact for university or higher attainment. Age has a positive but declining association with presenteeism. Even where they are significant, health risk behaviors have a minimal contribution to presenteeism. CCI has a positive association with increased presenteeism.

Discussion

The observation that the experience of pain, notably chronic severe pain, reduces labor force participation and increases absenteeism and presenteeism, is a recurring one in the pain literature. Breivik *et al.*[11] in their survey of chronic pain in Europe reported that one in four said their pain had impacted their employment status, 19% had lost their job because of pain, 16% had changed job responsibilities because of chronic pain and 13% had changed jobs entirely. At the same time, in the six months prior to the survey those in employment reported a mean time lost from work of 7.8 days due to pain. In terms of absence and reduced performance due to common pain conditions – lost productive time – the American Productivity Audit

Table 9. Presenteeism ordered logit regression results.

Regression model	Ordered logit regression: Model 1			Ordered logit regression: Model II		
Independent variables	Odds ratio	$p>\|z\|$	95% confidence interval	Odds ratio	$p>\|z\|$	95% confidence interval
Pain reported in last month*						
Mild	1.650	0.00	(1.464–1.860)			
Moderate	2.577	0.00	(2.390–2.779)			
Severe	5.518	0.00	(4.788–6.360)			
Pain level and frequency*						
Severe daily pain				7.319	0.00	(6.100–8.783)
Severe pain and 4–6 times a week				5.572	0.00	(3.896–7.969)
Severe pain and 2–3 times a week				4.703	0.00	(3.369–6.565)
Severe pain and weekly or less				2.215	0.00	(1.570–3.125)
Moderate daily pain				3.493	0.00	(3.058–3.990)
Moderate pain and 4– 6 times a week				3.049	0.00	(2.531–3.674)
Moderate pain and 2–3 times week				3.036	0.00	(2.650–3.477)
Moderate pain and weekly or less				1.646	0.00	(1.464–1.849)
Mild daily pain				1.879	0.00	(1.384–2.550)
Mild pain and 2–6 times a week				2.425	0.00	(1.928–3.049)
Mild pain and weekly or less				1.327	0.00	(1.141–1.544)
Socio-demographic variables						
Age: 40–59 years[1]	0.798	0.00	(0.755–0.843)	0.785	0.00	(0.743–0.830)
Age: 60 years and older[1]	0.594	0.00	(0.522–0.675)	0.574	0.00	(0.504–0.653)
Gender: male[2]	0.849	0.00	(0.804–0.896)	0.855	0.00	(0.810–0.903)
Education: high school completed [3]	0.982	0.65	(0.906–1.064)	0.992	0.85	(0.916–1.075)
Education: university or higher[3]	1.118	0.01	(1.030–1.213)	1.124	0.00	(1.036–1.220)
Income: €20,000–39,999[4]	0.930	0.04	(0.866–0.998)	0.932	0.05	(0.868–1.000)
Income: €40,000 and above[4]	0.893	0.00	(0.826–0.966)	0.898	0.01	(0.831–0.970)
Income: reporting declined[4]	0.865	0.00	(0.789–0.949)	0.868	0.00	(0.791–0.952)
Country: UK[5]	0.825	0.00	(0.769–0.884)	0.812	0.00	(0.757–0.871)
Country: France[5]	0.732	0.00	(0.683–0.783)	0.723	0.00	(0.675–0.774)
Country: Spain[5]	0.859	0.00	(0.774–0.953)	0.855	0.00	(0.770–0.949)
Country: Italy[5]	1.254	0.00	(1.150–1.367)	1.247	0.00	(1.144–1.360)
Health risk behaviors						
BMI: underweight[6]	1.287	0.00	(1.091–1.519)	1.277	0.00	(1.083–1.505)
BMI: overweight[6]	0.967	0.28	(0.910–1.028)	0.963	0.23	(0.906–1.024)
BMI: obese[6]	1.108	0.01	(1.030–1.193)	1.099	0.01	(1.021–1.183)
BMI: morbidly obese[6]	1.530	0.00	(1.284–1.824)	1.510	0.00	(1.267–1.801)
BMI: reporting declined[6]	1.134	0.14	(0.961–1.338)	1.128	0.15	(0.956–1.332)
Current smoker[7]	1.008	0.77	(0.953–1.067)	1.010	0.74	(0.954–1.068)
Alcohol user[8]	1.044	0.13	(0.987–1.104)	1.044	0.13	(0.987–1.104)
Morbidity/comorbidity status						
Charlson Comorbidity Index	1.313	0.00	(1.237–1.393)	1.305	0.00	(1.229–1.385)
Pseudo R^2 (MacFadden)	0.026			0.028		
Log likelihood	−51644.2			−51548.0		
n	28,882			28,882		

Note: Reference categories: *no pain reported in last month; [1]age 18–39 years; [2]females; [3]not completed high school; [4]income under €20,000; [5]country: Germany; [6]BMI normal weight; [7]non-smoker; [8]non-drinker.

concluded that pain was a common and disabling condition in the US workforce[4].

In the 2008 NHWS the estimated relationship between pain and labor force participation is substantial (Table 2). Among those persons reporting pain in the last month, only 34.85% report working full-time compared to 44.52% of those not experiencing pain. In terms of experiencing severe pain the estimate is 25.98%. The multinomial logit model confirms the magnitude of this difference (Table 7) in terms of the independent effect of pain. The estimated relative probability of being employed if severe pain is experienced is 0.266 compared to an estimated 0.427 among the no pain population. The association with persons reporting severe daily pain is even greater. The difference drops substantially for those experiencing mild pain with the survey yielding an estimate of 34.44% in full-time employment among those experiencing moderate pain, while the model yields an estimated probability of 0.368. Mild pain has no association.

The importance of these results is in the magnitude of the pain effect - notably the association of severe and moderate daily pain – allied with the overall prevalence of pain experienced in the five countries. Previous assessments of the impact of chronic disease have pointed to substantive effects - none, however, have considered pain in its own right. The pre-eminent contribution of pain as a determinant of labor supply decisions is brought out in the results of the logistic model (Table 6). Severe and moderate pain experience, with a frequency of greater than 2–3 times a

week, is strongly associated with labor force participation; a negative association that is only exceeded by the impact of age (persons 60 years and over). The association is greater than that associated with BMI (for those underweight and morbidly obese) and substantially greater than that for chronic comorbidities and other labor supply determinants such as education and gender. If pain is considered a disease in its own right then measures such as the CCI which attempt to capture the impact of comorbidities are failing to capture a key determinant of health status and workforce participation. Although CCI is significant in both Model I and Model II, the impact on participation is relatively small.

Taken at face value, these estimates of the contribution of pain to labor force participation represent a significant output loss as well as a potential and possibly avoidable claim on social security budgets. Reducing the prevalence of pain and returning people to employment offers substantial output gains. With an estimated 126.2 million of the no pain population in the labor force in these five countries (a labor force participation rate of 64.5%) and a corresponding 27.8 million (labor force participation rate of 55.9%) in the pain population, the labor force participation deficit is of the order of 4.3 million. If only 2 million of these are potentially capable of being returned to full-time employment, failure to do so (at an estimated average purchasing power parity 2009 GDP per capita of $34,000) means a GDP shortfall of some $72 billion. Reducing rates of absenteeism and presenteeism would further increase this estimate.

The experience of pain is not only associated with labor force participation, it also has a substantial association with absenteeism. This result confirms previous studies which have assessed the impact of chronic disease and specific pain conditions on both absenteeism and presenteeism. Once again, however, pain has been subsumed as an aspect of the chronic disease state considered. It has not been considered as an attribute or disease in its own right. Of particular interest here is not the fact that pain is associated with increased rates of absenteeism but the magnitude of the effect. There are a large number of studies that have assessed the impact of both acute and chronic disease on absenteeism – to include the experience of pain. None, however, have attempted to compare the severity and frequency of the experience of pain at a national level against the absenteeism experience of a no-pain reference group. Given this perspective, it is noteworthy that the presence of comorbidities, health risk factors and even sociodemographic characteristics, are eclipsed by the presence, not only of severe frequent pain but also, to a lesser extent, by moderate pain experience.

The association of pain with presenteeism mirrors that for absenteeism. The experience of pain, irrespective of severity or frequency has a significant negative contribution to presenteeism. There is a clear gradient relating the severity and frequency of pain to the incidence of presenteeism. Once again, the experience of pain overshadows the contribution of other health status characteristics.

Seen against the background of an ageing European population and projections of a more adverse ratio of active workforce members to dependents, pain presents not only as a major health problem but also as a legitimate target of microeconomic policy. This conclusion holds irrespective of whether or not the experience of long-term or chronic pain is seen as a condition that transcends specific disease conditions that may have been seen as the initial cause or more prosaically as a symptom that has failed to subside. If the results presented here are considered a guide, the experience of both severe and moderate pain is quantitatively more important that the more traditional health risk factors of BMI, alcohol use and smoking in its impact on workforce activities. These have been long-standing targets of health policy. Indeed, in a recent paper utilizing the same data set, the impact of severe and frequent pain had a substantially greater relationship with health related quality of life (HRQoL) and healthcare resource utilization than these traditional risk factors[22]. Raising the awareness of pain as a disease in its own right and recognizing pain as often badly managed, particularly at the primary care level, are obvious first initial steps. More importantly is the justification for investment in pain management programs and pain services. This can only be achieved if the economic costs of pain at the community, employer and individual level are better quantified. With limited healthcare resources, a comprehensive and believable case needs to be made for the costs and benefits, in purely monetary terms, of investments in pain interventions by both public agencies as well as private providers.

Limitations of the study

While the results presented here represent a critical new perspective on the experience of pain and the burden of pain in the EU in respect of labor force status, absenteeism and presenteeism, there are a number of limitations that need to be noted. First, the NHWS is an internet based survey and may not be representative of the populations of the five countries covered – particularly if there are potential biases in the extent to which internet access is available. While the extent of such biases are unknown, it is worth noting that internet penetration in all countries covered is in excess of 50%. Second, respondents are asked to report their experience of pain. Apart from the potential impact of recall bias, there is no separate clinical confirmation of the presence of pain and reported conditions and attributes that may be associated with pain experience. Third, the study is focused on the experience of pain. Apart from excluding a number of obvious acute

pain categories, there is no attempt to apply an arbitrary distinction between acute and chronic pain or between, for example, primarily neuropathic and primarily nociceptive pain. Nor is it possible to assess pain chronicity.

Conclusions

The experience of pain, in particular severe daily pain, is strongly and negatively associated with labor force participation in these five European countries as well as reported absenteeism and presenteeism. As a measure of health status, it clearly has a contribution that outstrips other health status measures - the presence of comorbidities and BMI. Whether or not pain is considered as a disease in its own right, the experience of chronic pain, as defined here, presents policy makers with a major challenge. The experience of pain not only represents a major health problem but also a challenge in microeconomic policy. Programs to relieve the burden of pain in the community clearly have the potential for substantial benefits both from an individual and employer perspective, of returning people to work as well as reducing losses from absenteeism and presenteeism. This would be seen not only in terms of both increasing labor force participation – with the focus on returning people to full-time employment – but also in reducing absenteeism and presenteeism for those in employment. The challenge for public and private sector strategies to reduce the burden of pain is to demonstrate the financial, as well as the quality of life benefits of competing options. Irrespective of whether or not chronic pain is considered a disease in its own right and irrespective of claims for poor pain management, intervention strategies must be shown to have an acceptable cost-benefit profile.

Transparency

Declaration of interest
This study was supported by Grünenthal GmbH, Aachen, Germany.

Declaration of financial/other relationships
P.L has disclosed that he is a consultant to Kantar Health, a company that undertook this analysis on behalf of Grünenthal. H.L. has disclosed she is an employee of Grünenthal GmbH. GM-S., A.N., J.P., and G.V. have disclosed that they are members of the Grünethal CHANGE PAIN advisory group.

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