Secular trends in work disability and its relationship to musculoskeletal pain and mental health: A time trend analysis using 5 cross sectional surveys (2002-2010) in the general population

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Abstract

Objectives

International evidence suggests that rates of inability to work because of illness can change over time. We hypothesised that one reason for this is that the link between inability to work and common illnesses, such as musculoskeletal pain and mental illness, may also change over time. We have investigated this in a study based in one UK district.

Methods

Five population surveys (spanning 2002-2010) of working age people aged >50 years and < = 65 years were used. Work disability was defined as a single self-reported item 'not working due to ill-health'. Presence of moderate-severe depressive symptoms was identified from the Mental Component Score of the Short Form-12, and pain from a full body manikin. Data were analysed with multivariable logistic regression.

Results

The proportion of people reporting work disability across the surveys declined, from 17.0% in 2002 to 12.1% in 2010. Those reporting work disability, one-third reported regional pain, one-half widespread pain (53%), and two-thirds moderate-severe depressive symptoms (68%). Both factors were independently associated with work disability, their co-occurrence was associated with an almost 20-fold increase in the odds of reporting work disability compared to those with neither condition.

Conclusions

The association of work disability with musculoskeletal pain was stable over time, depressive symptoms became more prominent in persons reporting work disability, but overall prevalence of work disability declined. The frequency and impact of both musculoskeletal pain and depression, highlight the need to move beyond symptom-directed approaches towards a more comprehensive model of health and vocational advice for people unable to work because of illness.

Summary box

What is already known?

- Musculoskeletal pain and mental health conditions are the leading causes of health related job loss and work disability. They commonly co-exist and where they do sickness absence and work disability is increased.
- It has been suggested that the association between musculoskeletal pain, mental health and work disability may change over time, and with increasing retirement age and a projected increase in the number of workers delaying retirement, it is important to examine the impact of the most common conditions in relation to a workers ability to maintain employment.

What are the key findings?

- Reporting of work disability remained stable between 2002 and 2010 with a prevalence of 12-17%.
- Of older workers reporting work disability one-third report regional pain, one-half report widespread pain and over two-thirds report depressive disorder. Reporting of widespread pain remained constant between 2002 and 2010 but mental health conditions increased in prevalence.
- Pain and depressive disorder were independently associated with work disability at all time points, increasing locations of pain (from regional to widespread) was associated with increased work disability, there were stronger associations when both pain and depressive disorder were present in combination.

How might these findings impact on policy or clinical practice in the foreseeable future?

- These findings suggest that prevention of the adverse occupational outcomes of older adults must have a broader focus and move beyond symptom directed approaches in clinical practice, towards a more comprehensive model of care incorporating vocational advice.

Introduction

For employees with poor health the ability to continue in work is associated with concerns around financial and lifestyle changes and maintenance of quality of life.[1] Employment plays an important part in an individual's social identity, financial stability and future health. Furthermore, maintaining work despite poor health is often therapeutic, promotes recovery and may lead to better health outcomes, although work or work capacity may be limited.[2] In this paper the focus is on people who are unable to work because of poor health. This can be described in terms specifically relating to the employee's current job where health limits their abilities to meet the requirements of their job, resulting in work absence or in leaving the workforce[3]. Or in wider terms that refer to the ability to engage in any work, where work disability is defined as a permanent or partial disablement for work purposes[4].

Many studies have suggested that musculoskeletal and mental health conditions are two of the leading reasons for health related job loss and work disability.[5-13] Musculoskeletal pain and depression commonly co-exist,[14] and having co-morbidities is associated with longer sick leave and increased work disability.[15] There is some suggestion that these associations may change over time[16], and with increasing retirement age and a projected increase in the number of workers delaying retirement due to shrinking retirement resources[17] it is important to examine the impact of the most common conditions in relation to a workers ability to maintain employment, and to identify the direction and extent of any such trends that are occurring.

The objectives of this study are;

Objective one: To identify time trends in the prevalence of work disability among older workers.

Objective two: To determine the associations of musculoskeletal pain and depressive disorder with work disability.

Objective 3: To investigate whether associations between musculoskeletal pain, depressive disorder and work disability have changed over time.

In order to address these objectives, we utilised five general population surveys of adults aged 50 and over in one UK region (North Staffordshire) which had similar designs and questionnaires and which occurred between the period 2002 -2010.

Methods

Musculoskeletal pain, depressive disorder, work status and demographic information were collected using comparable measures in five observational studies in North Staffordshire adopting the same sampling frame (sample of general practice registers), target population (adults aged 50 years and older) and survey administration procedures (standard 3-stage mailing, self-complete questionnaires). Of the population of Staffordshire approximately 63% of working age people are in employment (full-time or part-time), with approximately 26% of the population in managerial or professional occupations[25.26].

This current analysis utilises the baseline surveys of five of these studies to answer our research objectives: North Staffordshire Osteoarthritis Project 1 (NorStOP1) 2002, Project 2 (NorStOP2) 2002-03, and Project 3 (NorStOP3) 2004-05;[18] Self-Management in Osteoarthritis of the Hand study (SMOOTH) 2008-09;[19] and Clinical Assessment Study of the Foot (CASF) 2010.[20] Each of these studies recruited from separate population samples. The response rates of these population surveys were 70.2% for NorStOP1, 68.0% for NorStOP2, 70.4% for NorStOP3, 58.6% for SMOOTH and 55.6% for CASF.

Each study surveyed adults aged ≥50 years registered at general practices. In the UK, ~98% of the population are registered with a general practice hence their registers provide a representative sample of the general population. Participants were included in the analyses for this study if they reported that they were of working age (50 – 65 years for males and 50 – 60 for females – the upper limit reflects state retirement age (i.e, the age that individuals are eligible to draw their state pension) at the time of the surveys). On each survey participants reported their employment status with the following question and response options: What is your current employment status? Employed; Not working due to ill health; Retired; Unemployed/seeking work; Housewife; Other. Those who responded that they were 'not working due to ill health' formed the sample population of people with work disability and were compared with all the others regardless of their occupational status (employed or unemployed etc).

Location of pain sites in all the studies was ascertained by asking participants to shade areas of pain on full body manikins. Their responses were categorised into: i) no pain ii) regional pain iii) widespread pain. The widespread pain definition used was the American College of

Rheumatology criteria[21] and required: pain in the axial skeleton (cervical spine or anterior chest or thoracic spine or low back) plus pain in contralateral quadrants of the body. Participants with pain that did not fulfil the widespread definition were defined as having regional pain.

Moderate-severe depressive disorder were measured using the mental component of the Short-Form 12 Health Survey (MCS-12).[22] Higher scores on the MCS-12 represent better mental health with a score of 50 representing the general population norm. The cut-off point for distinguishing patients with and without moderate-severe depressive disorder followed Vialgut *et al* (2013).[23] In their study, it was demonstrated that in European populations the best screening cut-off score for the MCS-12 to evaluate depressive disorder at any time in the past 30 days was 45.6. In addition, in our studies we used the Hospital Anxiety and Depression Scale for Depression (HAD-S $\geq$ 8 as positive)[24] available in NorStOP1-3 and CASF (but not in SMOOTH) to confirm the construct validity of this cut-off point by determining the association between the two variables. Thus, individuals were separated into two groups based on this cut-off: either having moderate-severe depressive disorder or not.

Statistical analysis

Demographic characteristics (age and gender), musculoskeletal pain, depressive disorder and work status are presented using descriptive statistics by individual study (NorStOP1-3, SMOOTH and CASF) and overall. All people aged over the official UK retirement age at the time of the surveys (>65 years for men; >60 years for women) were excluded from the analyses reported in this paper.

To investigate the association of widespread pain (vs. no pain or regional pain combined), depressive disorder and time of survey with work disability due to ill health, a multivariable logistic regression model combining data from all five studies was performed with work disability due to ill health (vs. the remaining categories as a whole) as the dependent variable and adjusting for age, gender, and social status based on socioeconomic classification (calculated from most recent job title).[25,26] Survey time was defined based on the year of the surveys and treated as a discrete numerical variable. Number of survey stratified by study and year is shown in Supplementary Table 1. To assess whether associations changed over time, we then included interactions of widespread pain with survey year, and of depressive disorder

with survey year. We also included the interaction of widespread pain and depressive disorder. Interaction term was constructed using "variable_A#variable_B" command under logistic regression modelling using STATA 13. The effect due to interaction was assessed by adding the interaction term (as independent variable) in the same model, as well as their individual terms.

To assess whether difference in participation rate across studies affect the main findings, participation rate (numeric) was additionally included in the multivariable logistic regression models as an independent variable for adjustment. The findings were the same (data not shown).

Results

Across all surveys 13,103 in the relevant age-groups were recruited and 11,871 (91%) provided sufficient data (complete data on study variables) to be included in the analysis. There was little difference in age and gender between those included and excluded from the analysis (data not shown).

The age distributions were similar across all surveys, with a median age of 58 years for males and 55 years for females (Table 1). Distribution of gender was similar between NorStOP1-3 and SMOOTH (55-57% males), whereas in CASF the proportion of males was slightly higher (60%) (Table 1).

Table 1. Distribution of age, gender and work disability by study

A description of self-reported work status in the whole population and stratified by individual survey is shown in Table 1. The proportion of work disability due to ill heath was the highest in NorStOP1 (2002) at 17%. In NorStOP2 (2002/3) this figure was 16.5%, then an apparent drop occurred with the figures maintained between 12-14% in the later 3 surveys (NorStOP3 (2004/5), SMOOTH (2008/9) and CASF (2010)).

Association of musculoskeletal pain and depressive disorder with work disability

No pain was reported by 32% of participants, regional pain was reported by 44%, and widespread pain by 24%. In those reporting work disability due to ill health, only 11% reported no pain compared to 53% reporting widespread pain. In the employed group, the proportion of participants reporting no pain, regional and widespread pain was 36%, 46% and 19%, respectively (Table 2). Employment status stratified by pain count or score of the mental component of the Short-Form 12 Health Survey is also presented in Supplementary Table 2.

In all the studies, approximately half of the work disabled people reported widespread pain, with the highest being 57% in NorStOP1 (2002) and the lowest of 46% in NorStOP2 (2002/2003). No clear time trend was seen over the period (2002 - 2010) (Supplementary Figure 1).

Table 2. Employment status stratified by pain or depressive disorder status in all study participants

Of the whole survey population, 31% were defined as having depressive disorder. Of those with a work disability 69% were defined as having depressive disorder, compared to 24% of the participants who were employed (Table 2).

Of those participants reporting that they were work disabled, a higher proportion also reported depressive disorder (73-74%) in the most recent two studies (SMOOTH (2008/9) and CASF (2010)), than in the earlier studies (65-66%, NorStOP1(2002), NorStOP2(2002/3), NorStOP3(2004/5)) (Supplementary Figure 2).

Approximately 40% of people reporting work disability reported both widespread pain and depressive disorder (Table 3).

Table 3. Employment status stratified by combinations of pain with depressive disorder status in all study participants

Time trends in work disability

Overall, survey year as a linear trend from 2002-2010 was associated with decreased work disability due to ill health over the same period (OR 0.91 (0.88 – 0.94), per year). Both widespread pain and depressive disorder were associated with work disability, with the strength of association for depressive disorder (indicated by an interaction between depressive disorder and survey year not quite reaching statistical significance at 0.077), but not widespread pain, increasing over time (Table 4).

Table 4. Association of widespread pain and depressive disorder with health related work disability (2002 - 2010)

Association between pain, mental health and work disability over time

Including an interaction of widespread pain and depressive disorder showed an approximately 20-fold increased odds of work disability in those with both conditions compared to people with neither (Table 5).

Table 5. Interaction of widespread pain with depressive disorder in relation to work disability due to ill health

Discussion

Summary

This study has demonstrated a small but significant decline in the proportion of older adults who report work disability due to ill health during the period studied. The proportions of participants reporting pain remained constant across the time period of the surveys (2002-2010), but the association of depressive disorder with not working because of illness or disability became stronger across time. Whilst both pain and depressive disorder were independently associated with work disability, increasing locations of pain (from regional to widespread) was associated with increased work disability, and the combined effect of reporting widespread pain and depressive disorder together led to an almost 20 fold increase in the odds of reporting work disability compared to having neither.

Strengths and limitations

This is the first study to examine changes in pain, mental health and work status over such a long period of time. The principal advantage of this study is that it includes a very large pool of 11,871 survey participants drawn from the same district population, with different samples being drawn on five occasions over a period of nine years. This has allowed the examination of both the impact of pain and depressive disorder on work disability and the change in this relationship over time. By using the surveys as an integrated dataset the difficulty of heterogeneity associated with Individual Patient Data analysis is minimised. This study has also been conducted in the over 50 year age group, a relatively understudied group in terms of the examination of health and work and the contribution of health in the transition to work disability[17]. Furthermore, the consistent measures included in each of the surveys enabled the findings to be adjusted for age, gender and social class, each of which is known to be associated with work disability.

There are some potential limitations to the current analyses which need to be considered. The measure of work ability was limited to a single question asking participants to describe their work status (employed, unable to work due to ill health, retired, unemployed/seeking work, housewife/work full-time at home, other (e.g. student)). This only allowed participants to select one option, which had the advantage of clearly defining a work disability group (on the basis of selecting 'unable to work due to ill health') but with the disadvantage that the study does not distinguish between those who are on short or long-term, permanent or temporary, absence from work. Participants were asked to recall their musculoskeletal pain and mental health over the past 4 weeks. Although this is a very short period, it is still possible that recall bias may have affected the results. However, it is unlikely that participants would differentially recall the outcome measured of whether or not they were not working as a result of ill health and therefore, whilst the precision of our estimates may be affected by potential bias, it is unlikely that the direction of the observed effects would be influenced. The five separate studies were cross-sectional and it is possible work disability was caused by some other health condition and that the musculoskeletal or mental health problem arose after the start of work disability, there is also the possibility that the findings may be influenced by unmeasured confounders for example availability of suitable work, or educational attainment. One possible weakness in investigating trends over time between independently conducted surveys is that selective response might change over the years and bias the comparison between surveys. There is evidence that disabled people selectively under-participate in

surveys; if this differed across time we would expect comparable trends for physical and mental disability but this was not so and argues against such bias.

Comparison with other literature

Our study indicates that both pain and depressive disorder are associated with work disability in the population, that there is a graded relationship with pain extent and that the presence of both pain and depressive disorder is associated with a substantially higher risk of work disability. This finding is in agreement with recently published literature primarily from Scandinavian studies. Virtanen *et al* (2014)[27] reported that an absence of mental disorder was associated with extended employment and concluded that good mental health was a key factor in extending employment but only in conjunction with the opportunity to control work time. Whilst Virtanen *et al's* study was also conducted using survey data, they excluded those who were already work disabled and therefore conclusions cannot be drawn on the relative contribution of mental disorder to future work disability. Dorner *et al* (2016)[28] looked at the relationship of back pain and common mental disorders with future disability pension and found that the combined effects of pain and mental disorder had a greater impact on claiming disability pension than either condition alone. Dorner *et al's* study was based on register data, rather than self-report, and therefore likely to represent the more severe end of the spectrum of mental disorders i.e. diagnosed conditions rather than the mild, predominantly undiagnosed conditions reported in the surveys included in our study. Whilst our study can only hypothesise on the impact of pain and mental health conditions on retirement, a recent study based on Finnish health survey data reported an additive but not synergistic effect of common mental disorders and musculoskeletal disorders with regard to subsequent granting of disability pension i.e. there was no interaction between the conditions and each had an independent effect in terms of the granting of disability pension.[29] Overland *et al's* (2011)[30] study of registry data for individuals aged 40-46 identified widespread pain as a strong predictor of disability pension and also a predictor for pensioning due to mental disorders and other diagnoses. Furthermore our findings are supported by national data.[31]

Our findings about the relationships between pain, mental health and work disability are consistent with findings from earlier studies, and strengthens the novel observations from our study as the first to examine the time trends of the impact of pain and mental health on work disability.

Implications

Our confirmation of the continuing strong association between work disability and musculoskeletal pain and depressive disorder in older people, and especially of the two in combination, has to be set in the context of the trends which suggest a fall in the prevalence of work disability in the first decade of the 21st century together with an increasing prominence of depression in association with the inability to work. Given that pain and depression continue to be common disorder in the community, it is quite plausible that this, together with the rising age of retirement and of the population as a whole, may halt or reverse the decline in work disability. Clearly there are many other influences on work disability prevalence, including wider employment rates and the system for disability payments and certifications, but this work confirms the continuing importance of depressive illness as a component of work disability and the additional importance of pain and depression in combination.

From a clinical perspective, understanding the inter-relationship between pain and mental health in older adults is very important. Guidelines on management of these conditions consistently stress that patients presenting with one condition should be asked about disorder of the other, allowing appropriately comprehensive treatment plans that take account of the complexity of the interactions between the two can be identified and targeted advice provided.[32,33] There is evidence that appropriate multidisciplinary treatment and advice for managing pain and mental health conditions in combination could lead to the prevention of further disability in patients,[34] and our study highlights the potential that this could have for slowing or preventing the transition into work disability as a result of these conditions. However further research would be required to test this hypothesis. Managing pain and mental health conditions appropriately and successfully will reduce the costs associated with work disability.[35] There are non-medical opportunities to support patients presenting with pain and mental health conditions in managing their health in the context of their work through the provision of appropriate vocational advice. It has been demonstrated that condition management programmes, of which vocational advice is an example, are acceptable to patients as part of their package of healthcare.[36] However, vocational advice needs to be broad to ensure that all conditions are encompassed and to ensure that the primary health condition is addressed in addition to the vocational implications of that condition.[37] In fact, in the United Kingdom the National Institute for Health and Clinical Excellence (NICE) recommendation on return to work interventions for those already on incapacity benefits,

advocates integrated approaches to vocational advice to ensure that it also includes management of health conditions and financial support.[38] It is important to ensure that older adults are not excluded from vocational advice programmes. This is particularly pertinent when the rising retirement age is considered, meaning that individuals have a much longer working life and therefore their contributions to the workforce need to be given as much importance as their younger counterparts.

There are a number of social implications arising from the study. Firstly the rising retirement age and the subsequent need to work into older ages across European countries, has led to a 10.2% increase in employment in older workers (aged 55-64 years) in the decade spanning 2003-2013.[39] It can be hypothesised that if the proportion of older adults remaining in work is increasing then so too will the number reporting work disability due to ill health, even if the proportions with work disability have declined as observed in our study. There needs to be a review of policy to ensure that provision is made for the support of older employees to remain in the workplace or to take retirement due to ill health if required. Addressing the issues of pain and mental health may prevent unnecessary exclusion from the labour market, mitigating the adverse consequences of this exclusion in terms of the poorer economic status generally associated with worklessness, and the consequent further inequalities in health associated with this status. Appropriately managing the health and work interface could improve population quality of life and bring benefits to society from active engagement in the workforce.[40]

Conclusions

Work disability due to ill health is common among older working age adults, and pain and mental health conditions not only have individual impacts on work ability but also have a cumulative effect. These findings suggest that prevention of the adverse occupational outcomes in older adults must have a broader focus and move beyond symptom directed approaches towards a more comprehensive model of care for example incorporating vocational advice to support the management of health in the context of an individual's work.

Author contributions

PIF and PC conceived the study, and PIF, PC, JK and YC contributed to the study design. YC analysed the data. GWJ led and YC contributed to the writing of initial manuscript, and all

authors contributed to the interpretation of the data. All authors approved the final version of the manuscript submitted for publication. GWJ and YC equally contributed to the paper.

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Conflicts of interest

Gwenllian Wynne-Jones sits on the NICE Guideline Update Committee “Workplace health: long term sickness absence and capability for work”.

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Table 1. Distribution of age, gender and work disability by study

		NorStOP1 (2002)	NorStOP2 (2002/3)	NorStOP3 (2004/5)	SMOOTH (2008/9)	CASF (2010)	All
	Total	2,864	2,277	1,901	2,789	2,040	11,871
Age	Median age (IQR), male	57 (54 - 61)	57 (54 - 61)	58 (55 - 61)	58 (54 - 61)	58 (54 - 62)	58 (54 - 61)
	Median age (IQR), female	55 (53 - 58)	55 (53 - 58)	56 (53 - 58)	55 (52 - 58)	55 (52 - 58)	55 (53 - 58)
	Median age (IQR), both	56 (53 - 59)	56 (54 - 60)	57 (54 - 60)	56 (53 - 60)	57 (53 - 60)	56 (53 - 60)
Gender[1]	Male, number (%)	1,592 (55.6)	1,282 (56.3)	1,055 (55.5)	1,591 (57.1)	1,222 (59.9)	6,742 (56.8)
	Female, number (%)	1,272 (44.4)	995 (43.7)	846 (44.5)	1,198 (43.0)	818 (40.1)	5,129 (43.2)
Work status	Employed (%)	1,672 (58.4)	1,311 (57.6)	1,165 (61.3)	1,798 (64.5)	1,234 (60.5)	7,180 (60.5)
	Work disability due to ill health (%)	486 (17.0)	376 (16.5)	234 (12.3)	354 (12.7)	247 (12.1)	1,697 (14.3)
	Retired (%)	369 (12.9)	310 (13.6)	241 (12.7)	436 (15.6)	318 (15.6)	1,674 (14.1)
	Unemployed/Seeking work (%)	64 (2.2)	54 (2.4)	37 (2.0)	62 (2.2)	68 (3.3)	285 (2.4)
	Housewife/Work full-time at home (%)	154 (5.4)	140 (6.2)	131 (6.9)	111 (4.0)	72 (3.5)	608 (5.1)
	Other (e.g. student) (%)	119 (4.2)	86 (3.8)	93 (4.9)	28 (1.0)	101 (5.0)	427 (3.6)

IQR: interquartile range. [1] Gender distribution based on different inclusion criteria between males (50 – 65 years old) and females (50 – 60 years old).

Table 2. Employment status stratified by pain or depressive disorder status in all study participants

	Employment status *n* (%)						
Pain status	Work disability	Employed	Retired	Unemployed	Housewife	Other	Total
No pain	193 (11.4)	2,553 (35.6)	564 (33.7)	85 (29.8)	193 (31.7)	155 (36.3)	3,743 (31.5)
Regional pain	605 (35.7)	3,288 (45.8)	769 (45.9)	141 (49.5)	264 (43.4)	177 (41.5)	5,244 (44.2)
Widespread pain	899 (53.0)	1,339 (18.7)	341 (20.4)	59 (20.7)	151 (24.8)	95 (22.3)	2,884 (24.3)
Depression status							
No depressive disorder	535 (31.5)	5,448 (75.9)	1,325 (79.2)	185 (64.9)	420 (69.1)	308 (72.1)	8,221 (69.3)
Depressive disorder	1,162 (68.5)	1,732 (24.1)	349 (20.9)	100 (35.1)	188 (30.9)	119 (27.9)	3,650 (30.8)

Work disability: work disability due to ill health; unemployed: unemployed/seeking work; housewife: housewife/work full-time at home

Table 3. Employment status stratified by combinations of pain with depressive disorder status in all study participants

Combination	Employment status *n* (%)						
	Work disability	Employed	Retired	Unemployed	Housewife	Other	Total
No pain/no depression disorder	75 (4.4)	2,164 (30.1)	487 (29.1)	66 (23.2)	155 (25.5)	127 (29.7)	3,074 (25.9)
Regional pain/no depressive disorder	211 (12.4)	2,446 (34.1)	615 (36.7)	94 (33.0)	176 (29.0)	131 (30.7)	3,673 (30.9)
Widespread pain/no depressive disorder	249 (14.7)	838 (11.7)	223 (13.3)	25 (8.8)	89 (14.6)	50 (11.7)	1,474 (12.4)
No pain/depressive disorder	118 (7.0)	389 (5.4)	77 (4.6)	19 (6.7)	38 (6.3)	28 (6.6)	669 (5.6)
Regional pain/depressive disorder	394 (23.2)	842 (11.7)	154 (9.2)	47 (16.5)	88 (14.5)	46 (10.8)	1,571 (13.2)
Widespread pain/depressive disorder	650 (38.3)	501 (7.0)	118 (7.1)	34 (11.9)	62 (10.2)	45 (10.5)	1,410 (11.9)

Work disability: work disability due to ill health; unemployed: unemployed/seeking work; housewife: housewife/work full-time at home

Table 4. Association of widespread pain and depressive disorder with health related work disability (2002 - 2010)

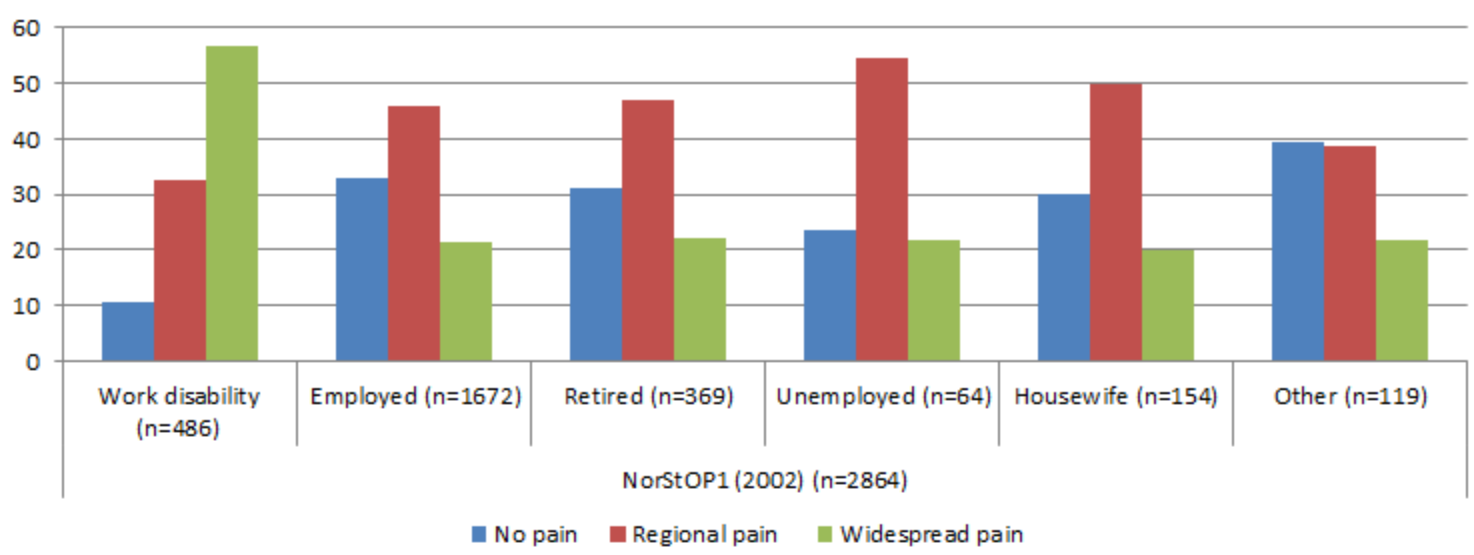
Independent variable	OR (95% CI)	p value
Age, per year	1.06 (1.04 – 1.08)	< 0.0001
Male	1.25 (1.09 – 1.43)	0.001
Lower social class[1]	1.63 (1.43 – 1.86)	< 0.0001
Widespread pain[2]	3.27 (2.60 – 4.11)	< 0.0001
Depressive disorder[3]	4.75 (3.77 – 5.98)	< 0.0001
Year of survey, per year	0.91 (0.88 – 0.94)	< 0.0001
Widespread pain[2] × year of survey		
Interaction -	1.0 (referent)	
Interaction +	1.01 (0.97 – 1.05)	0.75
Depressive disorder[3] × year of survey		
Interaction -	1.0 (referent)	
Interaction +	1.04 (1.0 – 1.08)	0.077

Outcome variable: Work disability due to ill health vs. the remaining categories as a whole.
[1] Higher status: large employers and higher managerial and administrative occupations; higher professional occupations; lower managerial, administrative and professional occupations; intermediate occupations; small employers and own account workers. Lower status: lower supervisory and technical occupations; semi-routine occupations; routine occupations. [2] Widespread pain (no pain or regional pain vs. widespread pain). [3] Depressive disorder (measured by the Mental Component of the Short-Form 12 Health Survey; No depressive disorder ≥ 45.6, Depressive disorder < 45.6).

Table 5. Interaction of widespread pain with depressive disorder in relation to work disability due to ill health

Independent variable	OR (95% CI)	p value
Age, per year	1.06 (1.04 – 1.08)	< 0.0001
Male	1.25 (1.09 – 1.43)	0.001
Lower social class[1]	1.63 (1.43 – 1.86)	< 0.0001
Year of survey, per year	0.94 (0.92 – 0.96)	< 0.0001
Widespread pain[2] × Depressive disorder[3]		
-/-	1.0 (referent)	
+/-	4.53 (3.71 – 5.51)	< 0.0001
-/+	6.97 (5.88 – 8.27)	< 0.0001
+/+	19.56 (16.40 – 23.33)	< 0.0001

Outcome variable: Work disability due to ill health vs. the remaining categories as a whole. [1] Higher status: large employers and higher managerial and administrative occupations; higher professional occupations; lower managerial, administrative and professional occupations; intermediate occupations; small employers and own account workers. Lower status: lower supervisory and technical occupations; semi-routine occupations; routine occupations. [2] Widespread pain (no pain or regional pain vs. widespread pain). [3] Depressive symptoms (measured by the Mental Component of the Short-Form 12 Health Survey; No depressive symptoms ≥ 45.6, Depressive symptoms < 45.6).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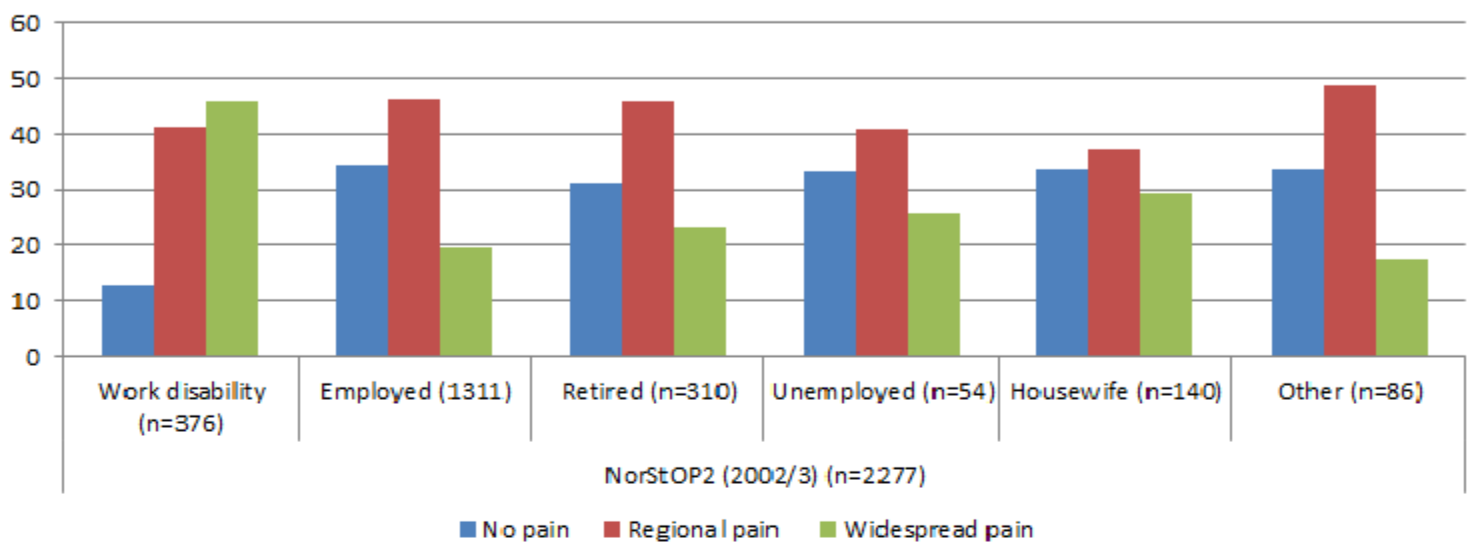
Employed (n=1672)
Retired (n=369)
Unemployed (n=64)
Housewife (n=154)
Other (n=119)
NorStOP1 (2002) (n=2864)
No pain
Regional pain
Widespread pain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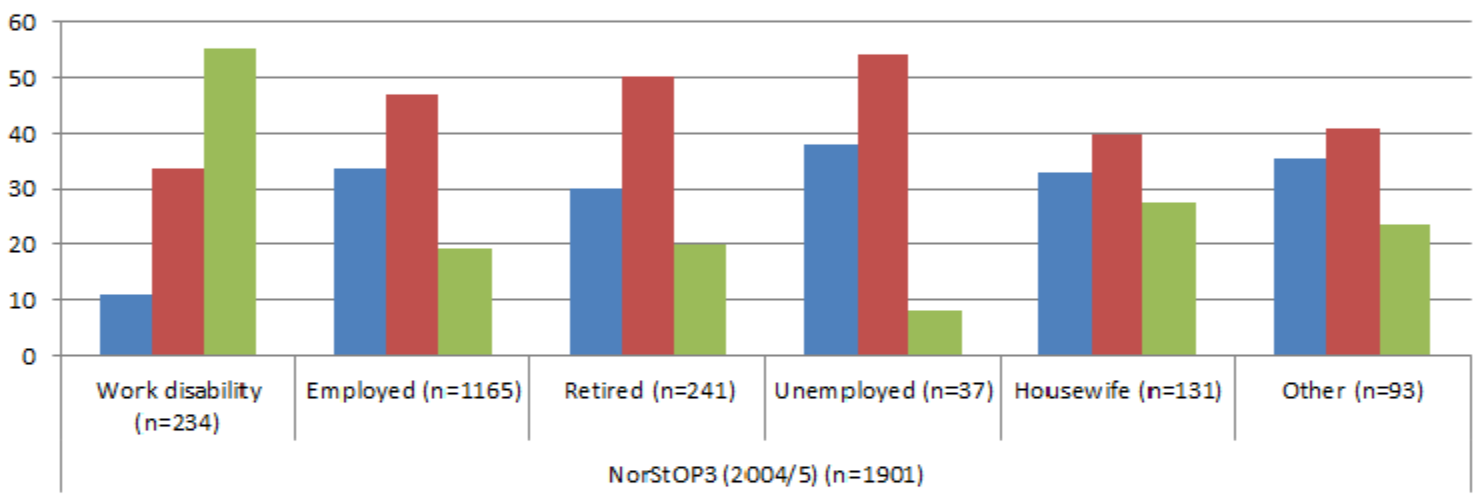
Work disability (n=376)
Employed (1311)
Retired (n=310)
Unemployed (n=54)
Housewife (n=140)
Other (n=86)
NorStOP2 (2002/3) (n=2277)
No pain
Regional pain
Widespread pain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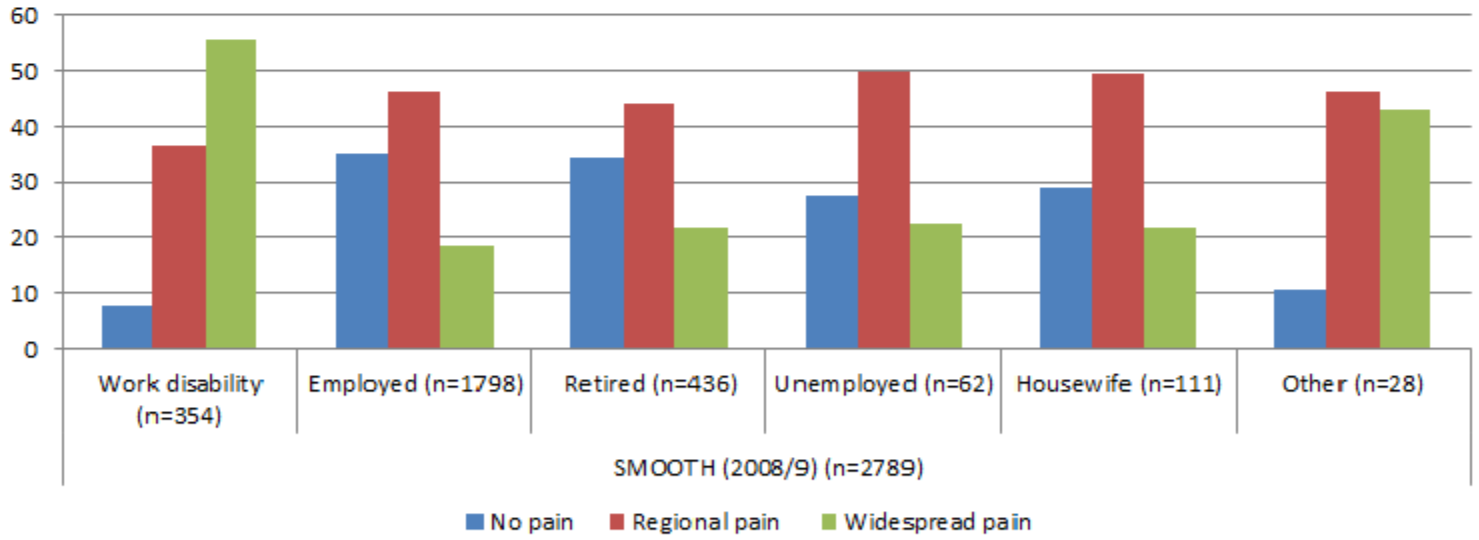
Retired (n=241)
Unemployed (n=37)
Housewife (n=131)
Other (n=93)
NorStOP3 (2004/5) (n=1901)
No pain
Regional pain
Widespread pain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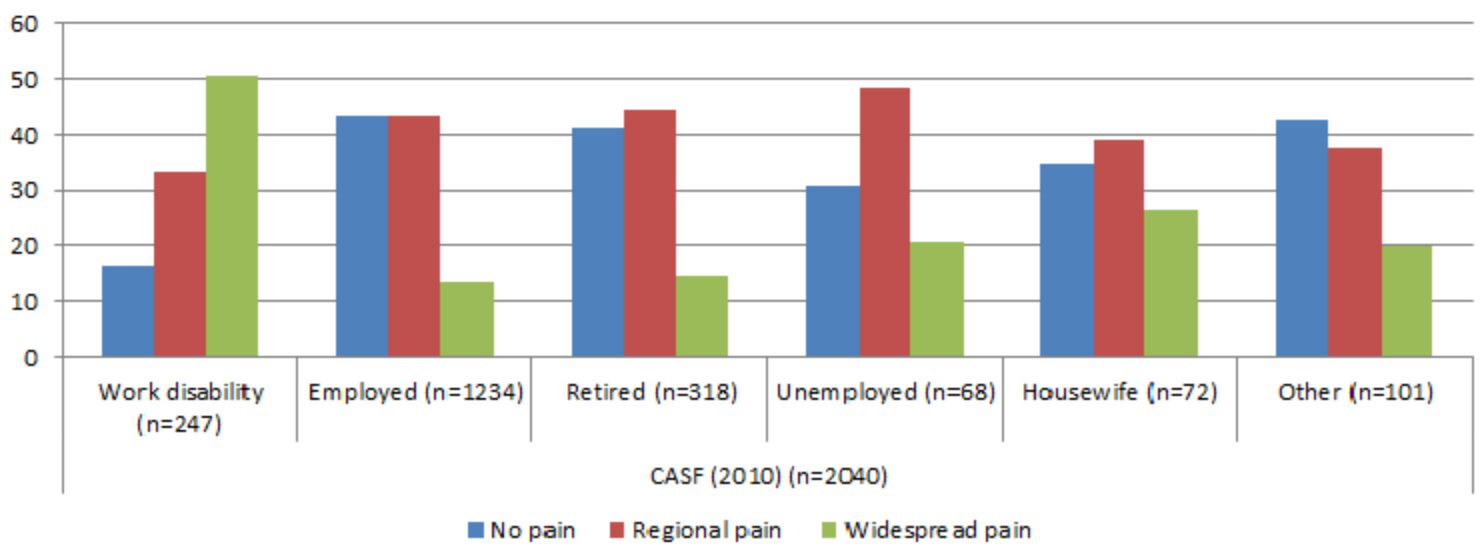
Work disability (n=354)
Employed (n=1798)
Retired (n=436)
Unemployed (n=62)
Housewife (n=111)
Other (n=28)
SMOOTH (2008/9) (n=2789)
No pain
Regional pain
Widespread pain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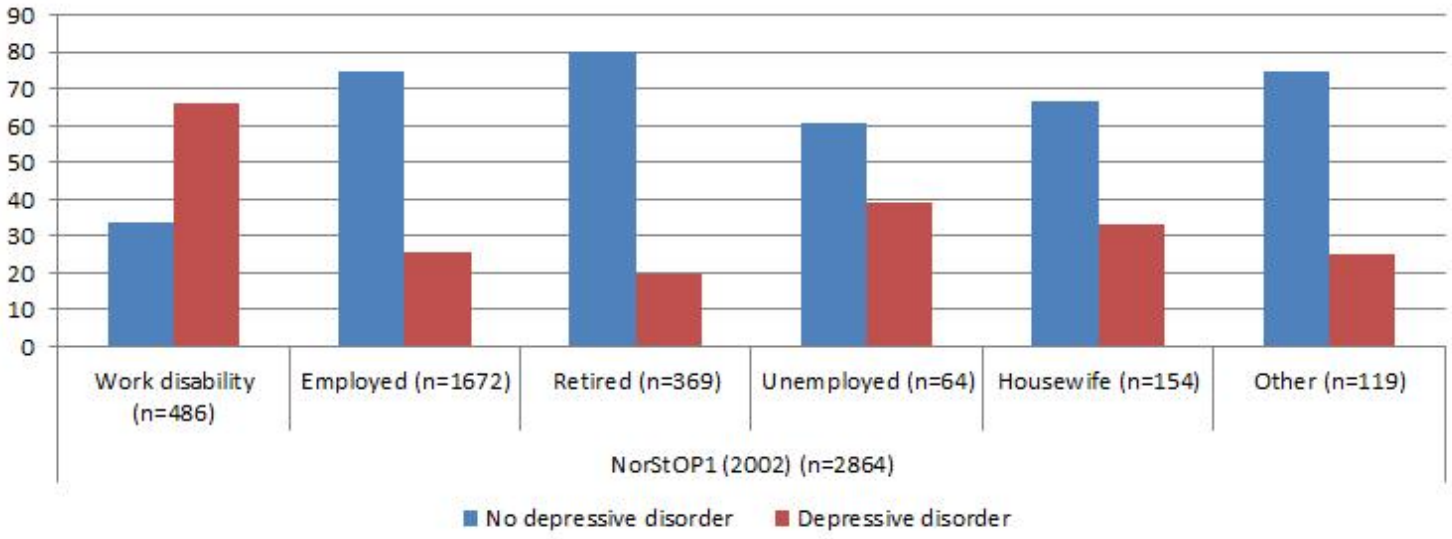
Work disability (n=247)
Employed (n=1234)
Retired (n=318)
Unemployed (n=68)
Housewife (n=72)
Other (n=101)
CASF (2010) (n=2040)
No pain
Regional pain
Widespread pain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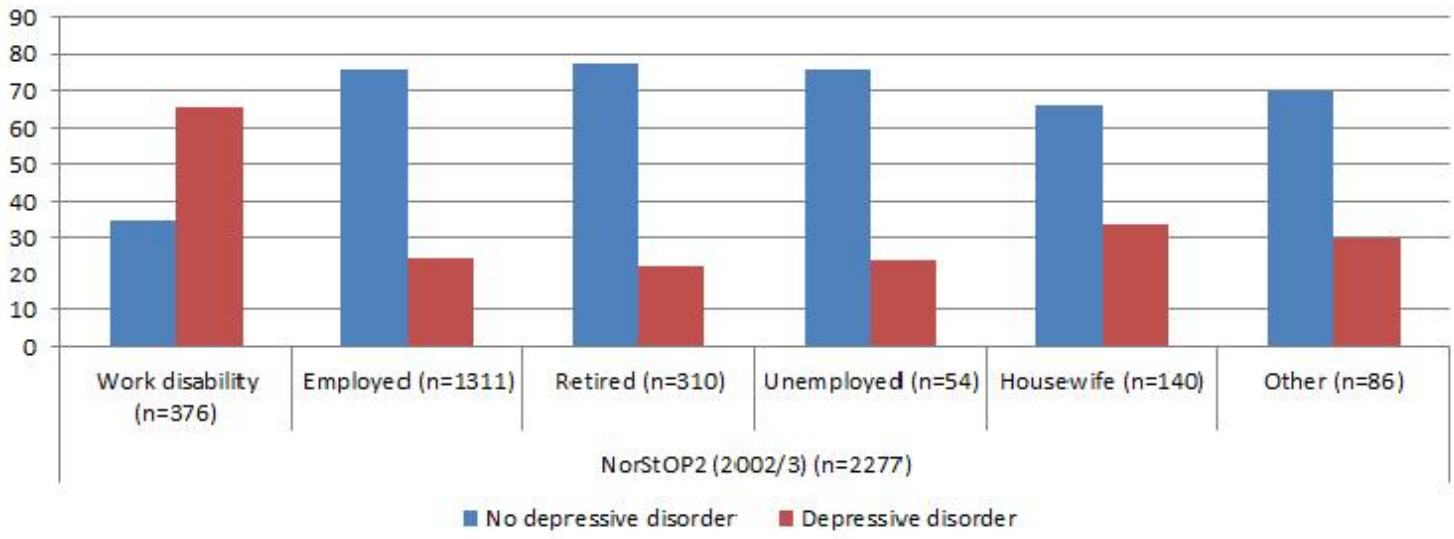
Retired (n=369)
Unemployed (n=64)
Housewife (n=154)
Other (n=119)
NorStOP1 (2002) (n=2864)
No depressive disorder
Depressive disorder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Work disability (n=376)
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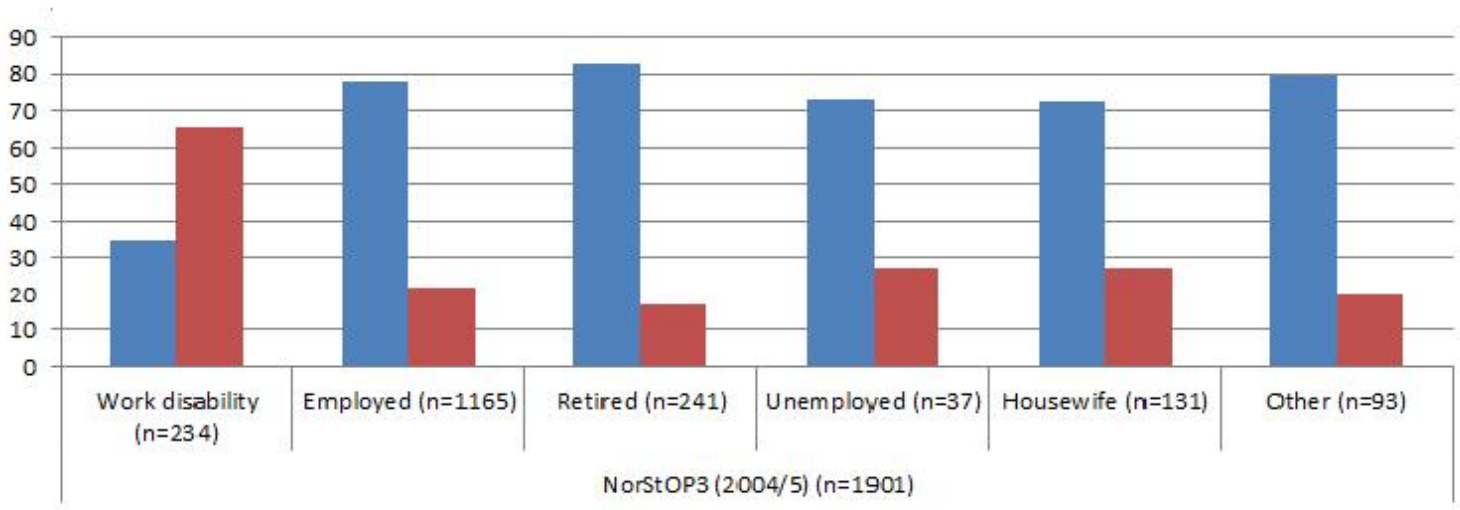
Depressive disorder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Work disability (n=234)
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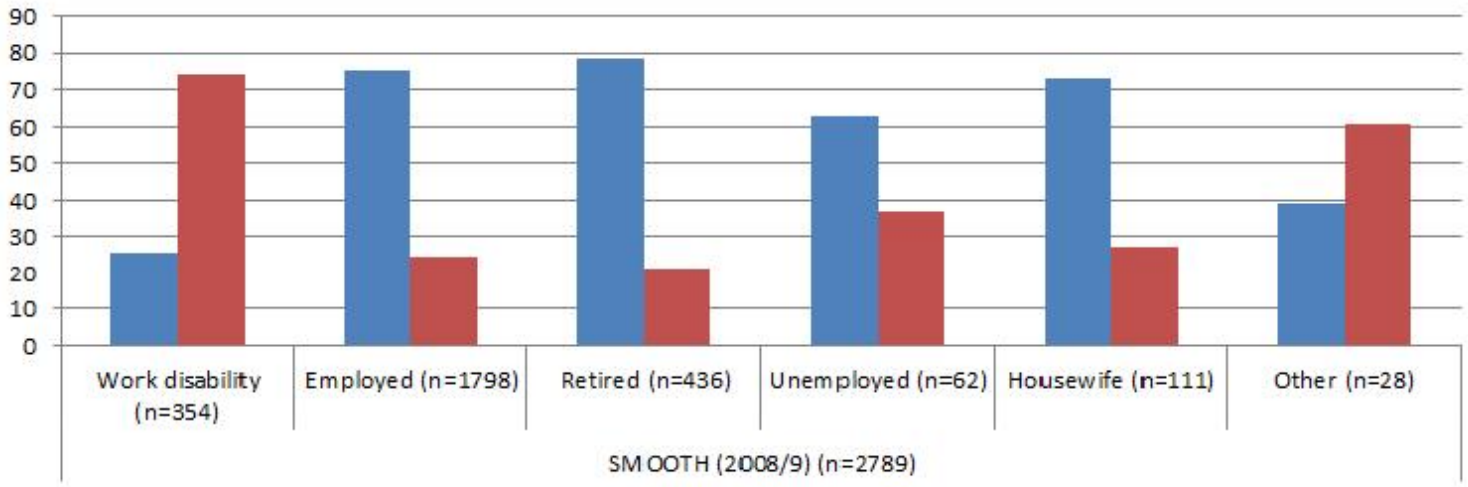
No depressive disorder
Depressive disorder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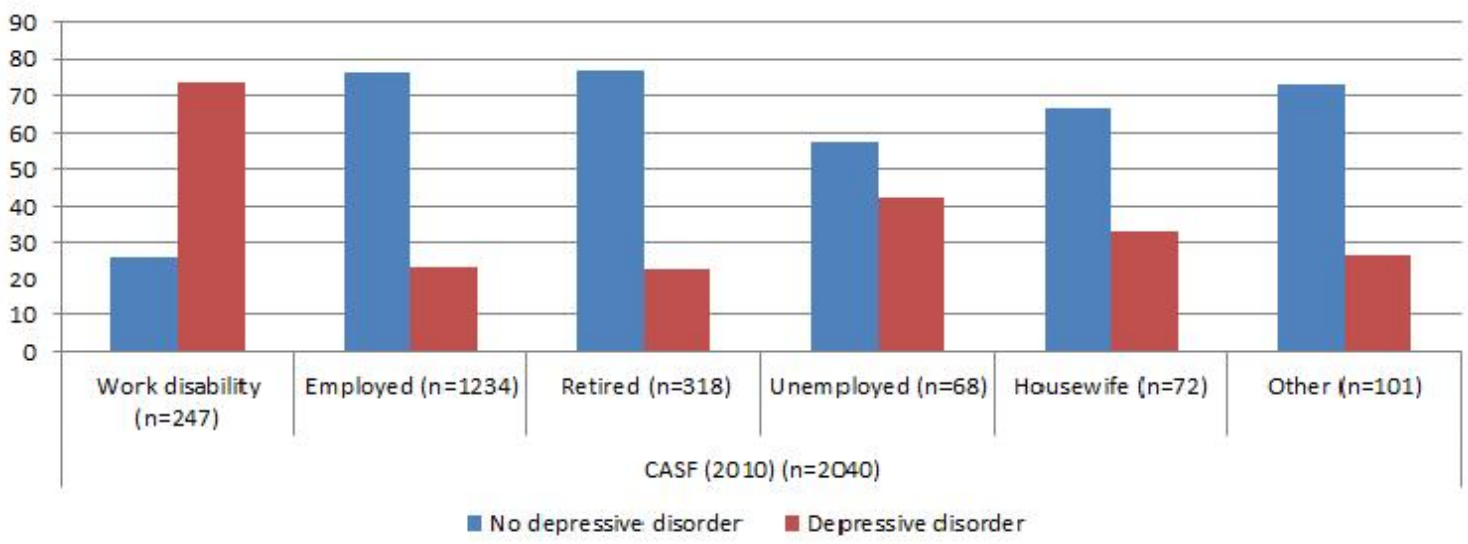
Depressive disorder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Work disability (n=247)
Employed (n=1234)
Retired (n=318)
Unemployed (n=68)
Housewife (n=72)
Other (n=101)
CASF (2010) (n=2040)
No depressive disorder
Depressive disorder

Suppl. Table 1. Number of survey stratified by study and year

Study	Year						
	2002	2003	2004	2005	2008	2009	2010
NorStOP1	2,864	0	0	0	0	0	0
NorStOP2	913	1,364	0	0	0	0	0
NorStOP3	0	0	1,772	129	0	0	0
SMOOTH	0	0	0	0	2,316	473	0
CASF	0	0	0	0	0	0	2,040

Suppl. Table 2. Employment status stratified by pain count or score of MCS-12 in all study participants

	Employment status *n* (%)						
	Work disability	Employed	Retired	Unemployed	Housewife	Other	Total
	7,180 (60.5)	1,697 (14.3)	1,674 (14.1)	285 (2.4)	608 (5.1)	427 (3.6)	11,871 (100.0)
Crude pain count, median (IQR)	11 (5, 21)	3 (0, 7)	3 (0, 8)	4 (0, 8)	4 (0, 9)	3 (0, 9)	4 (0, 9)
Adjusted† pain count, median (IQR)	11.3 (5.0, 20.6)	3.0 (0, 7.0)	3.0 (0, 7.7)	3.7 (0.3, 8.1)	4.5 (0, 9.1)	3.6 (0, 8.6)	4.0 (0, 9.1)
Crude MCS-12 score, median (IQR)	37.2 (29.7, 49.5)	53.7 (46.0, 57.8)	55.9 (47.6, 58.8)	52.5 (38.6, 56.7)	52.6 (42.0, 57.8)	53.2 (43.1, 57.9)	52.8 (42.2, 57.8)
Adjusted† MCS-12 score, median (IQR)	37.9 (29.8, 49.9)	53.7 (45.9, 57.6)	55.8 (48.7, 58.8)	52.5 (38.7, 56.6)	52.2 (41.6, 57.8)	53.4 (43.7, 58.0)	52.9 (42.8, 57.5)

MCS-12: the mental component of the Short-Form 12 Health Survey; IQR, interquartile range; work disability: work disability due to ill health; unemployed: unemployed/seeking work; housewife: housewife/work full-time at home; †adjusted for age, gender and social class (higher vs. lower status) using quantile regression models.