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Published in:
The Journal of Pain

DOI (link to publication from Publisher):
[10.1016/j.jpain.2023.05.009](https://doi.org/10.1016/j.jpain.2023.05.009)

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Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Vinstrup, J., Bláfoss, R., López-Bueno, R., Calatayud, J., Villadsen, E., Clausen, T., Doménech-García, V., & Andersen, L. L. (2023). Pain control beliefs predict premature withdrawal from the labor market in workers with persistent pain: Prospective cohort study with 11-year register follow-up. *The Journal of Pain*, 24(10), 1820-1829. <https://doi.org/10.1016/j.jpain.2023.05.009>

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Pain Control Beliefs Predict Premature Withdrawal From the Labor Market in Workers With Persistent Pain: Prospective Cohort Study With 11-Year Register Follow-up

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Abstract: While a range of work-related psychosocial factors has been associated with various pain disorders and early retirement, less is known about pain cognitions and their influence on premature exit from the labor market. Therefore, as a primary objective, this study investigates associations between pain control beliefs and risk of disability pension among Danish eldercare workers. In 2005, 2257 female eldercare workers with low-back and/or neck/shoulder pain > 90 days within the previous 12 months, replied to a survey and were followed for 11 years in a national register of social transfer payments. Using Cox regression, we estimated the risk of disability pension during follow-up from experiencing different levels of “pain control” and “pain influence,” controlling for pain intensity and other relevant confounders. In the fully adjusted model for pain control with “high” as reference, hazard ratios of 1.30 (95% CI 1.03–1.64) and 2.09 (95% CI 1.45–3.01) are observed for “moderate” and “low,” respectively, while the metric of pain influence shows hazard ratios of 1.43 (95% CI 1.11–1.87) and 2.10 (1.53–2.89), respectively. Pain control beliefs are associated with disability pension among eldercare workers with persistent pain. These results highlight the importance of evaluating not only bodily manifestations of pain, but also individual pain-related cognitions that may influence the experience of pain.

Perspective: This article addresses the complex experience of pain within an organizational context. We introduce the metrics of “pain control” and “pain influence” among workers with persistent pain, showing that the psychometric properties of these measures are prospectively associated with premature exit from the labor market.

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Keywords: Pain control, pain beliefs, chronic pain, musculoskeletal disease, work ability

Musculoskeletal pain disorders are one of the leading causes of disability, productivity loss, and social expenses, worldwide, with low-

back pain accounting for 57.6 million years lived with disability in 2016.¹ In the European Union and the United States, musculoskeletal disorders represent the

Received May 12, 2022; Received in revised form May 2, 2023; Accepted May 12, 2023

The authors report no conflicts of interest.

The study is supported by a grant from the Danish Parliament. The funder had no role in designing the study, data collection and analysis, decision to publish, or preparation of the manuscript.

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<https://doi.org/10.1016/j.jpain.2023.05.009>

largest work-related illness category,² as well as a burden that will likely continue to increase.³ Consequently, and not without considerable economic consequences, this puts significant strain on healthcare and social security systems, compelling policy makers to identify innovative, evidence-based solutions to address the issue of musculoskeletal pain.³ Traditionally, the majority of research on work-related risk factors has focused on physical aspects of the work environment, namely, accumulated physical exposure as a primary risk factor.⁴⁻⁷ Specifically in the field of health- and eldercare, the physical load associated with performing patient transfers has received much attention in the literature.⁸⁻¹¹ Unfortunately, within this organizational context, most ergonomic interventions have predominately failed to show any benefit when reviewed systematically.^{2,10,12-14}

Within the 2 previous decades, modern pain research has endeavored to explore the influence of areas related to psychosocial predictors of pain.¹⁵⁻¹⁹ Originating from this line of research, and with a foundation in the biopsychosocial model of health proposed by Engel,²⁰ the importance and prognostic value of various pain beliefs (ie, the thoughts and beliefs the individual has about their experience of pain) on outcomes related to pain and health have since been highlighted.²¹⁻²⁴ These metrics have shown to reliably predict pain intensity, pain-related disability, and physical function across age groups.^{22,25-34} Namely, while negative beliefs³⁵ are associated with a range of disorders characterized by persistent pain,^{32,36-39} positive beliefs of self-efficacy⁴⁰ are associated with favorable pain trajectories and health-related outcomes.³⁰ Although the gradual acknowledgment of psychosocial influencers has mostly been carried by conceptual research stemming from the biopsychosocial framework, it is only slowly edging its way forward within the field of occupational medicine.⁴¹⁻⁴³ For example, an increasing number of individual- and work-related psychosocial risk factors have been prospectively associated with musculoskeletal pain and injury among health- and eldercare workers,⁴⁴⁻⁴⁷—outcomes which, in turn, are known to significantly increase the risk of both sickness absence and premature withdrawal from the labor market.⁴⁸⁻⁵² However, while individual pain beliefs are an essential part of the pain experience⁵³ as well as the culture surrounding the understanding of pain,⁵⁴ surprisingly little is known about the influence and predictive capability of pain beliefs and outcomes related to work ability.⁵⁵

Adapted from the concept of self-efficacy, the notion of “pain control” (ie, positive expectancies about personal control over pain) has emerged as a synonym specific to the context of pain.⁵⁶⁻⁵⁹ For example, while likely influenced by both race, ethnicity, and culture,⁵⁷ a recent randomized trial found that pain control beliefs predicted the degree of improvement in individuals with persistent low-back pain.⁵⁶ Given the uncertainty in employment status and emotional stress characterizing workers with physically demanding jobs and musculoskeletal pain, it is crucial to investigate the associations between pain beliefs and work ability.

In light of the above, the present study primarily aimed to investigate associations between pain control beliefs and the prospective risk of disability pension in a sample of eldercare workers, hypothesizing that this single-item metric serves as a reliable predictor of premature exit from the labor market. If the relationship between pain control beliefs and disability pension is established, it would provide a timely, significant incentive for a wide range of stakeholders, including health- professionals and organizations as well as policy makers, to implement established clinical recommendations aimed at addressing unhelpful pain beliefs within the work environment.⁶⁰ This study highlights the potential economic- and societal benefits of utilizing single-item metrics related to pain beliefs, as their presence in organizational preventive strategies remains nonexistent.

Methods

Study Design and Population

This study utilized a prospective study design in combination with 11-year register follow-up, using the Danish Register for Evaluation of Marginalization (DREAM).⁶¹ Questionnaires were sent to 12,744 eldercare workers (comprised of nurses, healthcare assistants and helpers, therapists, and other care helpers with no or short-term education) in Denmark between 2004 and 2005, from which 9949 (78%) responded.⁴⁴ In order to investigate the prognostic value of the predictors described below, the current analyses include only workers having experienced low-back and/or neck-shoulder pain > 90 days (ie, “persistent pain”⁶²) within the previous 12 months, leaving a total of 2257 female eldercare workers (Table 1). The reporting follows the STROBE guidelines for prospective cohort studies.⁶³

Predictors and Outcome

Baseline values of “pain intensity,” “pain control,” and “pain influence” were included as predictors. Rated on a scale from 0 to 10, the former variable was directed towards both low-back and neck/shoulder pain and based on the questions “*within the previous 3 months, how would you rate your average pain intensity in your low-back?*” and “*within the previous 3 months, how would you rate your average pain intensity in your neck and shoulders?*” Likewise, using a 7-point Likert scale, “pain control” was quantified by the question “*how would you rate your ability to control your pain, enabling you to endure and manage?*”, whereas “pain influence” was quantified by the question “*how do you generally experience your ability to influence and diminish your pain?*” While “pain control” was the primary predictor, we also introduce the concept of “pain influence,” with the secondary purpose of quantifying its predictive capacity as well as to identify whether or not it differentiates from that of “pain control.” The outcome was disability pension during 11-years follow-up, using a dichotomized (yes/no) scale and based on data from the DREAM register. In Denmark, one is

Table 1. Characteristics of the Study Sample

	MEAN	SD	N	%
Baseline				
n			2257	
Age (y)	47.1	9.2		
Smoking (yes)			879	39.4%
Body Mass Index	25.3	4.5		
< 18.5			44	2.0%
18.5-24.9			1,149	53.2%
25-29.9			677	31.3%
≥30			291	13.5%
Pain intensity, low-back (0-10)	4.1	2.2		
0-2			477	21.6
3-4			729	33.0
5-6			690	31.3
7-10			312	14.1
Pain intensity, neck/shoulders (0-10)	4.7	2.3		
0-2			373	16.7
3-4			564	25.3
5-6			748	33.5
7-10			546	24.5
Level of pain control				
Low			150	6.8
Moderate			744	33.6
High			1,317	59.6
Level of pain influence				
Low			358	16.2
Moderate			987	44.7
High			863	39.1
Physical demands at work (0-7)	4.2	1.3		
Psychosocial work environment (0-100)				
Emotional demands	49.6	18.9		
Influence	41.5	20.9		
Clarity of roles	43.7	16.1		
Quality of leadership	53.4	22.6		
Level of leisure-time physical activity				
Low			1090	49.0
Moderate			1,042	46.8
High			93	4.2
Follow-up				
Incidence of disability pension*			426	19%
Pain control				
Low				31%
Moderate				21%
High				16%
Pain influence				
Low				27%
Moderate				20%
High				14%

NOTE. Values are presented as percentages and mean \pm SD.

*Denotes the incidence of disability pension based on sample groupings according to level of pain control and pain influence, respectively.

eligible for disability pension if one exhibits a significant and permanent loss of workability, whether due to disease or otherwise, which is evaluated on a case-by-case basis by the municipality (ie, work-, health-, education-, and social departments).

Covariates

Control variables include those related to the psychosocial work environment (ie, emotional demands, influence, clarity of roles, and quality of leadership;

scale 0–100, 100 being the best) from the Copenhagen Psychosocial Questionnaire,⁶⁴ ratings of physical work demands (0–7, 7 being the most demanding), levels of leisure-time physical activity (low, moderate, high), pain intensity (0–9), age, body mass index, smoking, and education.^{44,65,66}

Ethics

In agreement with the Danish Data Protection Agency, the National Research Centre for the Working

Environment is authorized to register all questionnaire studies in-house. According to Danish law, questionnaire- and register-based studies need neither informed consent nor approval from ethical and scientific committees.⁶⁷ All data were de-identified by Statistics Denmark and analyzed through remote access by the researchers.

Statistics

Using the Cox proportional hazards model, we estimated hazard ratios (HR) and 95% confidence intervals (95% CI) for receiving disability pension during follow-up. The predictive variables were "pain control" (categorical, low and moderate, reference: high) and "pain influence" (categorical, low and moderate, reference: high), respectively. The 2 predictive variables were not mutually adjusted for each other as they were moderately correlated (Pearson's $r = .58$). Importantly, both variables were adjusted for pain intensity. To put results into perspective, HR for pain intensity are also provided (continuous, HR's for one point increase). The follow-up was 11 years or until censoring, which comprises death, voluntary early retirement pension, state pension, or emigration. Potential registered disability benefit payment within the follow-up period was noncensored and referred to as event times. Estimation method was maximum likelihood, and the Proportional Hazards Regression (PHREG) procedure of SAS 9.4 (SAS Institute, Cary, NC, USA) was used. Model 1 was adjusted for age, education, and pain intensity (the latter only for the predictors "pain control" and "pain influence"). Model 2 was adjusted for age, education, BMI, smoking, leisure-time physical activity, physical work demands, psychosocial work factors, and pain intensity (the latter only for the predictors "pain control" and "pain influence"). An alpha level of $< .05$ was considered statistically significant.

The Danish Retirement System

The Danish retirement system is based on a pay-as-you-go model and has 2 main components: the state- and occupational pensions. In short, the state pension is a tax-funded, fixed-rate benefit that is available to all Danish citizens who meet a range of eligibility criteria, namely reaching the age of 67, having lived in Denmark for a minimum of 40 years while between the ages of 15 and 65, and having been a member of the labor market for a certain period of time. If a person has lived in Denmark for < 40 years, they can still receive state pension albeit at a proportionately reduced rate (ie, "fractional retirement pension"). The occupational pension, while not mandatory by law, is provided by the employer with the amount depending on the worker's salary and pension plan, and has a participation rate of more than 90% of all Danish workers.^{68,69}

In cases where the individual is unable to work until retirement age due to long-term illness or disability, one may qualify for early disability pension. In addition to being above the age of 40, the individual may be eligible if the physical- or mental condition is not

expected to improve, with a concurrent significant reduction in earning capacity; that is, "*with a permanent and significantly reduced work ability*" – Danish Agency for Labour Market and Recruitment (STAR). Prior to application, it is required that all relevant activation, rehabilitation, treatment, and other measures have been explored. Of note, in order to qualify, the individual has, unsuccessfully, attempted reemployment on numerous occasions, for example, by working part-time or flexible jobs. The application for disability pension is then evaluated by the municipality, taking into account the individual's medical history, documented work capacity, and their ability to participate in vocational training. In many cases, this process can take up to 3 years, during which the individual undergoes a range of work- and resource evaluations. It is worth noting that the eligibility criteria for receiving disability pension in Denmark are strict, with the process often being lengthy and complex, and far from all individuals with disability will qualify. In addition, eligibility is subject to review and periodically reevaluated, and may therefore be adjusted or withdrawn if the functional capacity of the individual improves. Therefore, the outcome measure of disability pension is widely used in the Nordic countries where disability- and pension systems are well established, as it provides a robust measurement of work ability.

Results

Table 1 shows information of the study sample of 2257 eldercare workers. Among these, 27 deaths and 426 cases of disability pension were registered during the 11-year follow-up period, with the highest prevalence of disability pension found in the groups experiencing low levels of pain control (31%) and influence (27%). Of note, high pain levels (≥ 5) were reported for both neck/shoulder (58%) and low-back (44%) in this population.

Table 2 shows associations between pain control, pain influence, pain intensity, and the prospective risk of disability pension; illustrating minimally- and fully adjusted HR's (ie, model 1 and model 2, respectively). Using "high" as reference, both metrics of pain cognition illustrate dose-response relationships with the outcome of disability pension.

In the minimally adjusted model for pain control, "moderate" and "low" control exhibit HR's of 1.18 (95% CI .96–1.46) and 2.03 (95% CI 1.46–2.82), respectively, while a similar risk pattern is observed for the metric of pain influence (ie, "moderate"; HR 1.24 [95% CI .98–1.56], "low"; HR 1.75 [95% CI 1.33–2.32]).

Similarly, in the fully adjusted model for pain control, HR's of 1.30 (95% CI 1.03–1.64) and 2.09 (95% CI 1.45–3.01) are observed for "moderate" and low, respectively, while the metric of pain influence show HR's of 1.43 (95% CI 1.11–1.87) and 2.10 (1.53–2.89).

Lastly, for every 1-point increase in pain intensity, a significant increase in risk is observed in both models (ie, model 1; HR 1.16 (95% CI 1.10–1.21) for low-back pain

Table 2. Levels of Pain Control, Pain Influence, Pain Intensity, and Associated Risk of Disability Pension

PAIN		MODEL 1		MODEL 2	
		HR	95% CI	HR	95% CI
Control	High	1		1	
	Moderate	1.18	(.96-1.46)	1.30	(1.03-1.64)
	Low	2.03	(1.46-2.82)	2.09	(1.45-3.01)
Influence	High	1		1	
	Moderate	1.24	(.98-1.56)	1.43	(1.11-1.87)
	Low	1.75	(1.33-2.32)	2.10	(1.53-2.89)
Intensity	Low-back	1.16	(1.10-1.21)	1.18	(1.12-1.24)
	Neck/shoulder	1.11	(1.06-1.16)	1.12	(1.06-1.18)

NOTE. Model 1: Adjusted for age and education.

Model 2: Adjusted for age, education, BMI, smoking, leisure-time physical activity, physical work demands, and psychosocial work factors.

For the predictors "pain control" and "pain influence," both models were controlled for pain intensity.

Analyses of pain control and pain influence were performed using categorical variables (low, moderate, and high [reference]), while the analysis for pain intensity was performed using continuous variables (HR's for one point increase).

Values are presented as hazard ratios (HR) with 95% confidence intervals (CI).

and HR 1.11 (95% CI 1.06–1.16) for neck/shoulder pain, model 2; HR 1.18 (95% CI 1.12–1.24) for low-back pain and HR 1.12 (95% CI 1.06–1.18 for neck/shoulder pain).

In subsequent analyses of correlation, we found the predictors "pain control" and "pain influence" to be moderately correlated (Pearson's $r = .58$, Spearman Correlation Coefficient = .53), while pain intensity was only weakly correlated with these (Pearson's r ranging from $-.18$ to $-.23$, and correlation coefficients from $-.15$ to $-.18$ in analyses of multicollinearity). Of importance, only variables related to the psychosocial work environment showed correlation coefficients above .25 (eg, between emotional demands and clarity of roles), while no coefficients related to pain control- influence-, or intensity were higher than .20.

Last, correlation coefficients between perceived physical workload and the 2 main predictors were also low ($-.13$ and $-.18$ for pain control and pain influence, respectively).

Discussion

The present study reports robust associations between ratings of "pain control" and "pain influence," and the outcome of disability pension among eldercare workers, assessed utilizing single-item metrics. Likewise, as shown in numerous studies, increasing levels of pain intensity were also associated with disability pension. However, pain intensity was only weakly correlated to pain control- and influence, illustrating the distinctiveness of these metrics. These results emphasize the importance of addressing psychosocial factors related to the individual's perception of pain, highlighting the importance of utilizing a biopsychosocial approach in the prevention and management of musculoskeletal pain disorders.

A range of factors may potentially explain why negative pain beliefs push workers out of the labor market and into the disability pension system. For example, it has been hypothesized that pain chronicity and disability within working populations are strongly

influenced by negative health beliefs and expectations through placebo mechanisms.⁴¹ The placebo effect (ie, higher pain intensity due to negative expectations)⁷⁰ is dependent on increased activity in nociceptive-processing areas, reduced dopaminergic- and opioidergic neurotransmission in pain-regulatory networks, and plays an essential role in developing anxiety and stress.⁷¹ This hypothesis is highly intriguing, as it would help clarify the association between pain beliefs and pain intensity,^{22,30,72-75} as well as the negative emotional impact caused by the (perceived) inability to engage in work-related activities.⁷⁶ In congruence with the present findings, Denison et al found – in 2 primary healthcare samples of patients with subacute, persistent, or recurring pain disorders – that pain-related beliefs serve as better determinants of disability than pain intensity.²⁷ Likewise, positive pain beliefs have been reported to mediate the prognostic effect of baseline pain intensity and disability, exemplified by the notion that individuals with low baseline pain intensity and concomitant low self-efficacy experience similar outcomes to individuals with high baseline pain intensity and high self-efficacy.⁷⁷ Additionally, in examining pain sensitivity and brain responses during an attention/distraction protocol in a sample of patients with fibromyalgia, Ellingson et al found that individuals displaying higher levels of catastrophizing were also less able to distract themselves from pain (ie, to modulate the pain experience), hypothesizing that negative pain beliefs represent a potent mechanism of persistent pain exacerbation.⁷³ Summarily, while it is evident that various pain beliefs predict, mediate and modulate both pain-related disability and the experience of pain itself, very little is known about these metrics and their prognostic value within organizational settings.

Alas, the closest equivalents are arguably the psychosocial risk factors traditionally attributed to the local work environment, – known to influence a range of physical- and mental health outcomes among the working population. For example, a recent meta-review reports pooled estimates of associations between

psychosocial work exposures (ie, job strain, decision latitude, psychological demands, and social support) and musculoskeletal disorders,⁷⁸ to which previous studies have established convincing associations for the outcome of long-term sickness absence.⁷⁹⁻⁸² However, while perceived stress likely mediates the link between organizational psychosocial risk factors and several adverse health outcomes,⁸³⁻⁸⁵ research on how individual pain beliefs influence these associations is surprisingly scarce. Among nurses, high levels of self-efficacy have been shown to modulate the relationship between perceived stress and components of physical- and mental health,⁸⁶ while increasing levels of “negative coping” (eg, denial, avoidance, withdrawal, etc.) likely negate this effect.⁸⁷ Therefore, investigating the influence of pain beliefs – with and without the presence of pain – in this population of the work force, is highly warranted.

Perspectives

While we have recently confirmed the association between musculoskeletal pain and risk of disability pension among this population of eldercare workers,⁸⁸ and the use of single-item metrics in identifying work-related stress in healthcare workers,⁸⁹ it is evident that the recognition of pain beliefs as predictors of numerous outcomes related to health and productivity – including sickness absence and disability pension – is sorely missing in the organizational literature. Assuming that self-efficacy is, at least partially, task- and context-specific,^{90,91} it logically follows that the success of any workplace intervention is dependent on whether or not it addresses issues directly related to the local work environment, and the individuals within it.⁹¹ While complete transferability to an organizational context is questionable, it has – among the general population – been found that the main barriers to improve (pain-related) self-efficacy primarily relate to health literacy, access to appropriate healthcare, and social support.⁹² Therefore, it is likely that workplaces, aiming to decrease rates of sickness absence and disability pension, will benefit from a renewed focus on employee education on topics related to pain reconceptualization and health.⁹³

Strengths and Limitations

The primary strength is the utilization of high-quality national registers on disability pension, allowing for 11-years follow-up. Limitations of the present study include those inherently related to questionnaire surveys; that is, common-method-, non-response-, and recall bias.^{94,95} Further, while representing the job group of female eldercare workers and thus reducing the risk of socioeconomic confounding, it is unknown whether the presented associations are applicable to the general working population, or males in similar occupations. However, as the included predictors relate more to human biases and cognition than to any specific job category or function, it is likely that the results reflect an important issue across occupations. Additionally,

because a number of unpredictable circumstances (eg, substantial societal-, economical-, or cultural changes) are possible to have influenced either the predictors (ie, how the sample population think about their pain) or the outcome (ie, retirement processes in Denmark) during a period of time spanning more than a decade, the present results should be interpreted with potential historic- and contextual confounders in mind. To this end, the financial crisis of 2008 and changes to the disability pension- and retirement systems, are likely candidates. For example, while voluntary early retirement is considered a “pull” factor, that is, enabling workers to retire early, it has previously been suggested that senior workers experiencing deteriorating health, may choose to remain employed until eligible for early retirement, instead of applying for disability pension.⁹⁶ In Denmark, in order to qualify for early retirement pension, the employee has to pay a monthly fee for a duration of at least 30 years, while being full-time employed. However, while we do not present data on how many became unemployed or changed occupation during the follow-up period, any changes to the retirement system at any time during the follow-up period would likely have influenced the sample population to a similar degree. Therefore, while the absolute number of disability cases may have been lower or higher depending on the direction of change within the retirement system, the relative risks (and hence the presented associations) likely remain unchanged. Likewise, because engaging in a physically demanding job is considered a predictor for exiting the labor market through voluntary early retirement⁹⁷ and any job-rotation occurring within our sample is highly likely to have been towards less physically demanding tasks, the presented associations on disability pension are likely conservative.

Conclusions

Pain control beliefs are associated with disability pension among eldercare workers with persistent pain. These results highlight the importance of evaluating not only bodily manifestations of pain and injury, but also individual pain beliefs that may influence the experience and perception of pain, and thereby long-term outcomes related to work ability. Within the organizational context with the aim of ensuring a long and healthy work life, increased awareness of workers' level of health literacy and approach to the experience of pain, is warranted.

Author contributions

JOV, **TCL**, and **LLA** concocted the idea for the present analyses, and all coauthors approved the final plan before running the analyses. **LLA** performed the statistical analyses. **JOV** drafted the manuscript, and all coauthors provided critical comments and suggestions for improving the manuscript. All authors have read and approved the final version.

Data Availability

Researchers interested in using the data for scientific purposes are welcome to contact Prof. Lars L. Andersen, lla@nfa.dk.

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Acknowledgments

The authors thank the coworkers from the Danish Health Care Worker Cohort (DHCWC) 2004 study group for their contribution to the data collection.

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