The importance of a healthy lifestyle despite chronic pain: Prospective cohort with 11-year register follow-up

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ABSTRACT

The purpose of the study was to investigate to which extent a healthy lifestyle in female healthcare workers with chronic pain contributes to reducing the risk of disability pension. We conducted a prospective cohort study with an 11-year registry follow-up.

Overall, 2386 Danish female healthcare workers with chronic pain completed a questionnaire about work and lifestyle (leisure-time physical activity, smoking, and body mass index (BMI)). Data on disability benefit payments were obtained from the Danish Register for Evaluation of Marginalization. Two models (minimally and fully adjusted for different potential confounders) were tested using the Cox proportional hazards model.

During the follow-up period, 17.9% of the healthcare workers obtained disability pension. Low levels of leisure time physical activity (reference: moderate level) increased the risk of disability pension in the minimally (Hazard Ratio: 1.38 (95% CI: 1.14–1.69)) and fully adjusted models (Hazard Ratio: 1.27 (95% CI: 1.04–1.56)). Being highly physically active, as opposed to being moderately active, did not confer additional protection. Additionally, a positive association was observed between smoking and disability pension in the minimally adjusted model (Hazard Ratio: 1.27 (95% CI: 1.05–1.54)). BMI was not an influential factor. In female healthcare workers with chronic pain, at least moderate levels of physical activity is a protective factor for disability pension. Effective promotion strategies should be designed for both workplace and non-workplace settings.

1. Introduction

Chronic pain is a common problem in the general population, with pain-related diseases considered the leading cause of disability worldwide (Vos et al., 2017). The concept of chronic pain is understood, according to the International Association for the Study of Pain (Scholz et al., 2019), as pain that lasts beyond the normal healing time of tissues, generally considered to be three months (Scholz et al., 2019). There are several risk factors that predispose to chronic pain, whether psychological, sociodemographic or physical (Mills et al., 2019). Furthermore, previous research indicates that young working women may experience higher levels of musculoskeletal pain and disability compared to their male counterparts (Dabbagh et al., 2022). These disparities could be due to biological differences, such as lean muscle mass, endocrine function

or sex hormones, or to cultural gender stereotypes that lead women to perform more repetitive and monotonous movement work, increasing their risk of pain (Treaster and Burr, 2004; Bartley and Fillingim, 2013).

One of the groups with the highest prevalence of chronic pain is healthcare professionals, due to their elevated exposure to long-term musculoskeletal injuries and the need to maintain body postures that generate muscular discomfort and pain (Mroczek et al., 2020). On the other hand, psychological factors related to job demand (Gustafsson et al., 2020), job dissatisfaction, fatigue, or stress also significantly increase the risk of musculoskeletal pain among these work groups (Vinstrup et al., 2020). Healthcare workers are at higher risk of developing sustained musculoskeletal injuries, leading to long-term sick leave (Andersen et al., 2020). This in turn increases the risk of early retirement, receiving a disability pension, which is associated with high costs

and negative consequences for people, jobs and societies (Andersen et al., 2020).

Physical activity has been seen to have positive effects on chronic pain, with an improvement in quality of life (Mills et al., 2019; Saridi et al., 2019; Suh et al., 2019; Sundstrup et al., 2016) as well as multiple beneficial effects on physical and mental health and well-being (Sundstrup et al., 2016). In addition, it has also been shown to help reducing the risk of absence due to illness (Ervasti et al., 2019), suggesting that being physically active during midlife is associated with a lower risk of disability retirement (Lahti et al., 2016). Despite this, a significant proportion of the world population remains physically inactive (Saridi et al., 2019). In case of healthcare workers, the lack of free time and rotating work shifts, in addition to the demand and responsibility in their activities together with family problems, make it difficult to plan and carry out leisure time physical activity (Sundstrup et al., 2016). In this group, specifically in elderly caregivers, physical activity has been shown to be related to preventing the receipt of a disability pension (Morera et al., 2022). However, the aforementioned study did not include participants with chronic pain, a condition that could increase the risk of disability pension and that requires special attention. Furthermore, despite the importance of physical activity in the management of chronic pain (Saridi et al., 2019; Suh et al., 2019; Makino et al., 2019; Vader et al., 2020), there is a dearth of research investigating the advantages of maintaining physical activity levels among healthcare workers who experience chronic pain. This knowledge gap represents a missed opportunity to encourage healthy behaviors and mitigate the prevalence of disability pensions and their attendant negative outcomes. The objective of this study was to investigate whether physical activity in female healthcare workers with chronic pain contributes to reducing the risk of disability pension. It was hypothesized that female health professionals who do not practice leisure time physical activity despite chronic pain have a higher risk of obtaining an early disability pension. A secondary aim was to examine the association between other potential risk factors such as smoking and BMI and disability pension.

2. Methods

2.1. Study design

This prospective cohort study with an 11-year register follow-up follows the STROBE guidelines (von Elm et al., 2007). Baseline information was collected between late 2004 and spring of 2005.

Inclusion critera was as follows: women healthcare workers in eldercare in Denmark with chronic pain of >90 days during the last year in at least one of the following regions: low-back, neck-shoulder and/or knees. Eldercare workers comprised social and healthcare assistants and helpers, other care helpers with no or short-term occupational education, and nurses or therapists. The questionnaire was sent to 12,744 healthcare workers in eldercare in Denmark, obtaining 9949 responses (78%). Of the total sample, male respondents ($n = 234$) and workers who were not directly engaged in care services ($n = 1021$ of which some were also included in the male population of 234) were excluded from the present analyses. Therefore, the final sample of participants with chronic pain of >90 days during the last year in the low-back, neck-shoulder and/or knees was 2386 female healthcare workers in eldercare.

The Danish Data Protection Agency was notified of and registered the study. According to Danish law, questionnaire- and register-based studies need neither approval from ethical and scientific committees nor informed consent. All data was de-identified and analyzed anonymously.

2.2. Exposure factors

Self-reported level of leisure-time physical activity was assessed with a single question: 'Which description most accurately reflects your

pattern of leisure-time physical activity within the previous 12 months?' Respondents chose one of the following response categories (ranging from low to high duration and intensity): (i) Mainly sedentary or light physical activity for <2 h per week (e.g., reading, watching television, going to the cinema); (ii) Light physical activity for 2–4 h per week (e.g., going for a walk, light gardening, light physical exercise); (iii) Light physical activity for >4 h per week or vigorous physical exercise for 2–4 h per week (e.g., fast jogging or cycling, heavy gardening, exercise where you are sweating and breathing heavily); and (iv) vigorous physical exercise for >4 h per week or regular training/competitions several times per week (Saltin and Grimby, 1968). Subsequently, categories i and ii were merged and defined as 'low physical activity', category iii as 'moderate physical activity', and category iv as 'high physical activity'. Smoking was defined from the question 'Do you smoke?', with the response categories 'yes', 'I did smoke, but I quit', 'I have never smoked'. The first category was defined as 'smoker' and the latter two merged into 'non-smoker'.

BMI (kg/m2) was determined from the self-reported height and weight of the respondents [BMI = weight (kg)/ height2 (m2)]. Consequently, BMI was categorized according to the World Health Organization classification of underweight (<18.50), normal range (18.50–24.99), overweight (25–29.99), and obese (>30.00).

2.3. Outcome

Data on disability benefit payments were obtained from the Danish Register for Evaluation of Marginalization (DREAM) (Hjollund et al., 2007). Disability benefit payments can be obtained when the municipality decides that the worker has permanent full or partial loss of work ability, following a process that involves work-, health-, occupational education-, and social-departments.

Depending on the degree of work ability, an individual can receive either a full disability pension (this implies a complete cease of the workforce) or disability benefits (this entails partial work or modification of the working conditions). For the present study, a 'disability pension' was defined as any type of disability benefit as a result of permanent full or partial loss of work ability, including flex or sheltered jobs, and a full disability pension, involving a total of 13 categories of disability benefits payment in the DREAM register (Quist et al., 2014).

2.4. Confounders

Potential confounders from the baseline questionnaire included age (continuous variable), occupational education (categories of specific healthcare occupational education, e.g., social and health care assistant, social and health care helper, nurse, nurse aide, therapist, none), psychosocial work factors (emotional demands, influence at work, role conflicts, quality of leadership), physical work environment (physical exertion during work), number of chronic pain regions, depressive symptoms and previous long-term sickness absence. We chose these to control for all of these possible confounders to ensure robust and accurate findings. These included age, to account for varying health and work capacities across different age groups; occupational education, recognizing the diverse work conditions across healthcare professions; psychosocial work factors like emotional demands and quality of leadership, acknowledging their influence on mental health and job satisfaction; physical work environment, considering the direct impact of physical health risks; the number of chronic pain regions, as this is strongly associated with reduced work ability; depressive symptoms, highlighting the role of mental health in lifestyle and work ability; and previous long-term sickness absence, providing a context for current health status and potential future disability risk.

2.5. Statistical analyses

Using the Cox proportional hazards model (PHREG procedure of SAS

9.4, SAS Institute, Cary, NC, USA) we estimated hazard ratios (HR) and 95% confidence intervals (95% CI) for a disability pension. Participants were followed up for 11 years in the DREAM register or until censoring, which occurred for voluntary early retirement pension, state pension, emigration. Death was included as competing risk according to the cumulative incidence function of Fine & Gray (Fine and Gray, 1999). When an individual had a registered disability benefit payment in any given week within the follow-up period, the survival times were non-censored and referred to as event times. Multiple imputations replaced missing values.

Two models were tested. Model 1: Adjusted for age and mutually for the three lifestyle factors. Model 2: Model 1 + psychosocial and physical work environment, occupational education, number of chronic pain regions, depressive symptoms and previous long-term sickness absence. *P*-values <0.05 were considered as statistically significant.

3. Results

A cohort of 2386 female healthcare workers with chronic pain (mean age 47.1 years) participated in the study. Table 1 shows full baseline descriptive data. During 11-year follow-up, 17.9% of the sample (427 workers) were granted disability pension.

4. Discussion

The main finding of this investigation was that low levels of leisure-time physical activity increase the risk of disability pension among female healthcare workers with chronic pain. Although being highly physically active does not confer additional protection, increasing

Table 1

Baseline descriptive data of included female healthcare workers with chronic pain from Denmark.

	N	Mean	SD	%
Age	2386	47.1	9.2	
Smoking				
No	1445			60.6
Yes	941			39.4
Body mass index (kg/m^2)				
Underweight	46			1.9
Normal weight	1249			52.4
Overweight	749			31.4
Obesity	342			14.3
Physical acitivity level during leisure				
Low	1160			48.6
Moderate	1126			47.2
High	100			4.2
Physical exertion during work (Vos et al., 2017; Scholz et al., 2019; Mills et al., 2019; Dabbagh et al., 2022; Treaster and Burr, 2004; Bartley and Fillingim, 2013; Mroczek et al., 2020)	2386	4.2	1.3	
Psychosocial work factors (0−100)				
Emotional demands	2386	49.5	18.9	
Influence at work	2386	42.1	21.1	
Role conflicts	2386	43.4	15.9	
Quality of leadership	2386	53.8	22.2	
Number of body regions with chronic pain				
1	1600			67.1
2	598			25.1
3	188			7.9
Depressive symptoms (major depressive inventory, 0−46)	2386	9.4	7.1	
Previous long-term sickness absence				
No	2116			88.7
Yes	270			11.3

Low levels of leisure time physical activity (reference: moderate level) increased the risk of disability pension among female healthcare workers with chronic pain in both Model 1 and 2. Being highly physically active does not confer additional protection. In addition, a positive association was observed between smoking and disability pension in Model 1, although this was not the case in Model 2. Table 2 shows the main results.

Table 2

Associations between lifestyle and disability pension in female healthcare workers with chronic pain from Denmark during 11-year follow-up.

			Hazard ratio (95% CI)		
	n	%	Model 1	Model 2	PAR*
Smoking					
No	1445	60.6	1	1	
			1.27	1.20	
Yes	941	39.4	**(1.05–1.54)**	(0.98–1.48)	
BMI					
			1.53	1.24	
Underweight	46	1.9	(0.86–2.70)	(0.69–2.25)	
Normal weight	1249	52.4	1	1	
			1.06	1.03	
Overweight	749	31.4	(0.85–1.33)	(0.83–1.29)	
			1.28	1.13	
Obesity	342	14.3	(0.97–1.69)	(0.84–1.51)	
Leisure time physical activity					
			1.38	**1.27**	
Low	1160	48.6	**(1.14–1.69)**	**(1.04–1.56)**	
Moderate	1126	47.2	1	1	11.6%
			1.04	1.06	
High	100	4.2	(0.60–1.79)	(0.60–1.86)	

Model 1: Adjusted for age and mutually for the three lifestyle factors
Model 2: Model 1 + psychosocial and physical work environment, education, number of chronic pain regions, depressive symptoms and previous long-term sickness absence
 * Population attributable risk (PAR) only calculated for significant HR's of model 2 (non sign HR's set to 1)

physical activity to a moderate level could potentially prevent 11.6% of new disability pensions in this group. Therefore, workers with chronic pain should try to achieve at least moderate levels of physical activity in leisure time, but not necessarily be highly physically active.

Our findings on physical activity show us that low levels among female health workers increase the risk of obtaining a disability pension, both when adjusting the results for age and lifestyle (smoking, BMI, and physical activity), as well as for psychosocial factors, education, areas with chronic pain, depression and previous disability pensions. Consistent with our findings, a controlled trial in nurses with recurrent non-specific low back pain concluded that increasing physical capacity with interventions based on exercise and education applied immediately after the workday can reduce the development of chronic pain and work disability (Suni et al., 2016). Another cohort study with a 7-year follow-up conducted in a Norwegian population concluded that the physical component in health-related quality of life was a strong predictor of disability pension due to musculoskeletal diseases (Haukenes et al., 2014). The scientific literature has demonstrated the capacity of exercise to alleviate musculoskeletal pain via various pathways, as different endogenous systems are activated during and after, resulting in the release of substances or neurotransmitters, such as opioids, nitric oxide, serotonin, catecholamines, and endocannabinoids, which can modulate the perception of pain (Endogenous Systems Involved in Exercise-Induced Analgesia, 2018; Matei et al., 2023).

Interestingly, we have found that a high level of physical activity in leisure time does not confer additional protection against disability pensions, albeit it is recommended to maintain at least a moderate level, which is easier to achieve and could improve the practical application of our findings. Partially in line with these finding, a study conducted in employees with chronic musculoskeletal pain found a significant association between vigorous physical activity overall and a lower risk of disability pension, but this was not the case when the analysis was adjusted for different factors (Mather et al., 2019). This threshold of association with physical activity suggests that to achieve greater benefits in the population with chronic pain, other mental health or psychosocial factors should be considered. Nonetheless, contrary to our findings, a cohort study involving healthy workers proposed that the

reduced risk of disability pension is associated with vigorous physical activity, and that transitioning from high-intensity to moderate or low levels of physical activity may elevate that risk (Lahti et al., 2016). This could be explained by the fact that reducing the intensity of physical activity in a healthy and active subject from vigorous to moderate or mild can imply a decrease in health status and therefore suppose a risk factor.

Our results show that smokers have a higher risk of obtaining a disability pension when the minimally adjusted model is considered, but this association disappears with the fully adjusted model. Contrary to our findings, a systematic review in healthy workers concluded that smoking increases both the risk and the number of days absent due to illness in the active population, regardless of gender, age, and occupational class differences (Troelstra et al., 2020). To quantify the benefits of quitting smoking in terms of reducing the risk of work disability, one longitudinal study estimated that quitting smoking is likely to reduce the relative risk of long-term sickness absence by 11%, compared with continuing to smoke (Airaksinen et al., 2019). Since work-related musculoskeletal pain is one of the main causes of incapacity for work and absence due to illness, a cross-sectional study among 10,000 adults from the general working population showed a dose-response association between smoking and the intensity of musculoskeletal pain in the lower back and neck-shoulder area, being greater in smokers (Kirsch Micheletti et al., 2019). Nevertheless, prior investigations were conducted on cohorts consisting of healthy individuals, whereas our study focused on a population with chronic pain, which may explain the observed distinctions. It is conceivable that the impact of smoking on disability pension risk is less significant than that of chronic pain.

Regarding BMI, we found that it was not a risk factor of disability pension in either of the two models analyzed. A previous study (Reber et al., 2018) in healthy individuals highlighted the longitudinal association between weight excess and a higher probability of sick days as well as long-term absenteeism in women. Another study (Ervasti et al., 2019) in healthy subjects reported that excessive work disability would be reduced between 3% and 4% if overweight people increased their physical activity to the average level of people with normal weight. In addition, the authors found that overweight people who are physically inactive would reduce their risk of work disability by approximately 20% by becoming physically active (Ervasti et al., 2019). These findings are noteworthy given the evidence that obesity and chronic pain often co-exist, and that obesity is linked with numerous diagnoses of generalized chronic pain (Okifuji and Hare, 2015). A meta-analysis investigating the relationship between excessive body weight, physical inactivity, and disability pension and early retirement highlighted the necessity of workplace health promotion programs aimed at reducing these risk factors (Robroek et al., 2013). The lack of an association between BMI and disability pension in our investigation may be attributed to the inclusion of physical activity levels and BMI itself as confounding factors, as well as the fact that our study participants experienced chronic pain, in contrast to other healthy cohorts.

Our study has certain limitations. One limitation is that the predictor and confounding variables were measured only at baseline and therefore time-varying changes that may have occurred over time are not considered. Also, we cannot rule out the possibility of misclassification bias due to lack of recall and the possibility of under-reporting of predictors and confounding. Furthermore, our results cannot be extrapolated to male healthcare workers or to specific healthcare job groups. We controlled the analyses for occupational education as well as a range of other potential confounders. However, we did not have sufficient statistical power to stratify for healthcare job group, which may be considered a limitation. Future studies should consider to distinguish between different healthcare job groups under different work difficulties and demands. In addition, it should be considered that only 4.2% of our sample performed high levels of physical activity and this might influence the results. A limitation is the lack of cause-specific disability benefit payments as recorded in the Danish Register for Evaluation of Marginalization (DREAM). Finally, the possibility of reverse causation cannot be discarded. A strength of our study was the large sample size and the long follow-up period. In addition, disability pension data were obtained from national registries with full follow-up measures, therefore no selection or attrition bias affected our result.

5. Conclusions

In female healthcare workers with chronic pain, at least moderate levels of physical activity is a protective factor for disability pension. Because physical activity appears to be more relevant than other lifestyle factors in mitigating the risk of disability pension, effective promotion strategies to at least achieve moderate levels of physical activity should be implemented at workplace and non-workplace settings.

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CRediT authorship contribution statement

Joaquín Calatayud: Writing – original draft, Validation, Investigation. **Laura Perelló-Romero:** Writing – review & editing, Investigation. **Rodrigo Núñez-Cortés:** Writing – review & editing, Investigation. **Rubén López-Bueno:** Writing – review & editing, Validation, Methodology, Investigation. **Thomas Clausen:** Writing – review & editing, Conceptualization. **Lars Louis Andersen:** Writing – review & editing, Supervision, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available upon reasonable request to the corresponding author.

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