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Sick leave due to low back pain. The association with self-reported physical demand, fear avoidance and exposure to physical demanding workloads. A Cross-Sectional Study.

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Abstract

Objectives: To investigate if self-reported high physical demand at work, objective physical workload using a job exposure matrix (JEM) and fear avoidance beliefs are risk factors for sick leave in persons with low back pain (LBP). Secondly, to investigate if the effects of fear avoidance and self-reported high physical demand at work on sick leave are modified by the objective physical workloads.

Settings: Participants were recruited from general practice and by advertisement in a local newspaper.

Participants: 305 participants with LBP, a current period of 2 to 4 weeks and self-reported difficulty in maintaining physically demanding jobs due to LBP were interviewed, clinically examined and had an MRI at baseline.

Main outcome measures: Independent variables were high fear avoidance**,** self-reported high physical demand at work and objective measures of physical workloads (JEM). Outcome was self-reported sick leave due to LBP in the previous year. Logistic regression and tests for interaction were used to identify risk factors and modifiers for the association with self-reported sick leave.

Results: Self-reported physically demanding work and high fear avoidance were significantly associated with increased risk of prior sick leave due to LBP with OR 1.75 95%CI(1.10-2.75) and 2.75 95%CI(1.61-4.84) respectively. No objective physical workloads had significant associations. There was no modifying effect of objective physical workloads on the association between self-reported physical demand at work/ high fear avoidance and sick leave.

Conclusions: Occupational interventions to reduce sick leave due to LBP should focus more on those who rate their work as physically demanding and have high fear avoidance beliefs about work, and less on identification of individuals with the objectively highest physical workload.

Trial registration: The GoBack trial was registered with ClinicalTrials.gov (identifier: NCT02015572) on 29 November 2013

Strength and limitations of this study.

- A strength of this study is the combination of fear avoidance score and self-reported and objective workload exposures in relation to sick leave to overcome the validity problem with self-reported exposures
- Data were obtained from a clinically relevant sample of participants with low back pain.
- Only participants with self-reported physically demanding or very demanding work were included in the study with risk of lacking contrast among the participants and thus between the groups.
- Use of JEMs and dichotomizing of the exposure data without a golden standard regarding cut-off values entails risk of misclassification of exposure.

INTRODUCTION

Background

Low back pain (LBP) is a common musculoskeletal disorder and is one of the leading causes of disability for the working population. [1,2] In the US low back and neck pain accounted for the third-highest amount with estimated health care spending of $87.6 billion.[3]

The risk factors for developing LBP are believed to be a complex combination of both mechanical and physiological factors, and psychological, social and cultural factors.[4] Systematic reviews have concluded that no single intervention is likely to be effective to prevent LBP, due to its multidimensional nature.[5–7]

Psychological factors such as high fear avoidance beliefs (FAB) has proven to be an important prognostic factor for poor outcome in patients with nonspecific LBP[8] and as such have a predictive effect on sick leave. [9,10] FAB is believed to influence the perception of pain resulting in catastrophizing, fear and avoidance of physical activities. This leads to a vicious cycle of fear avoidance behaviour, physical deterioration and social isolation – factors which may affect the ability to stay in job.[10]

Self-reported workload exposures have been investigated as risk factors for LBP in the majority of studies [11–13] despite the fact, that self-reported workload exposures may entail a validity problem as individuals with musculoskeletal complaints tend to overestimate their exposures.[14], A job exposure matrix (JEM) is a classification system linking occupation and industry titles with job-related exposures.[15] This could be more accurate estimating the real exposure of physical

demands because of reduction misclassification of exposure. However, we do not know if a JEM is better at predicting risk of sick leave. JEMs have been shown to be an independent and valid measurement of physical demands in patients with primary hip and knee osteoarthritis [16], may be useful in the assessment of exposure for LBP patients, and be a predictor for sick leave.

Objective

The objective of the study was 1) to investigate to what degree self-reported high physical demand at work, physical workload using the job exposure matrix and fear avoidance beliefs are risk factors for sick leave in a group of persons with low back pain and 2) if the effect of fear avoidance and self-reported high physical demand at work on sick leave is modified by the objective measures of physical workloads.

METHODS

Design and Ethics

The study was based on cross-sectional baseline data from a randomized controlled trial (the GoBack trial, NCT02015572) [17] and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines – the STROBE.[18] All participants gave written informed consent before enrolment and the study was approved by the local ethics committee (H-3-2013-161) and the Danish Data Protection Agency ((DPA approval number 2014-41-2673).

Participants and setting

Participants between 18 and 65 years of age with a current episode of 2 to 4 weeks of LBP and a self-reported physically demanding job were recruited from general practice, the outpatient clinic of the Department of Rheumatology, Frederiksberg Hospital, Denmark and by advertisement in a local

newspaper. Potential participants were interviewed by telephone and screened for inclusion. Participants responded to "How physically demanding is your current job?" and only those responding demanding or very demanding were included. Furthermore, the participants needed to express concerns about the ability to maintain their current job and they had to have current employment for at least 30 hours/week. Individuals with pregnancy, other severe somatic or psychiatric disease, cancer or metastatic disease, severe co-morbidity, treatment or referral to outside providers (for example surgery) or contraindications for having a conventional MRI were not included.

Variables

At the first visit (baseline) participants filled in a battery of questionnaires on a validated touch screen[19], underwent a physical examination and an MRI. The questionnaires investigated demographic information, comorbidity, job-category, previous history of LBP, physically demanding work, leisure-time, physical activity, psychosocial work environment, general health status, history of work-related factors, work ability, back-specific disability, fear avoidance beliefs, pain score and sick leave due to LBP. Diagnosis was based on symptoms, clinical examination and MRI.

Sick leave due to LBP was recorded by answering the following questions at baseline: "how many days of sick leave have you had due to LBP in the previous year?" Categorized as short (1-7 days), medium (8-30 days), long (31-90 days), very long (over 90 days) or every day. Sick leave due to LBP was then dichotomized as low (1-7 days/year) and high (≥8days/year) due to overall low sick leave among the participants.

Fear avoidance beliefs was assessed with the 16-item Fear-Avoidance Beliefs Questionnaire (FABQ).[20] FABQ-W is the sum of seven items (score range 0-42 points) with each item scored

on a seven-point Likert scale from strongly disagree (0-points) to strongly agree (6-points). We defined high fear avoidance beliefs as FABQ-W>20 points.[21]

Physically demanding work was evaluated both by self-report (having a very demanding or having a demanding current job) and with the use of the Lower Body Job Exposure Matrix (JEM).[16]

Job titles from the baseline questionnaires were transformed into an occupational title in the Danish version of the International Standard Classification of Occupations (D-ISCO-88).[22] The JEM consisted of 168 D-ISCO codes which were divided into 121 job groups. Occupational medicine experts assessed physical exposures during a working day and estimated time sitting, time standing/walking, time with whole body vibration, time kneeling, and lifting (cumulated weight and number of heavy lifts>20 kg) in different jobs. The JEM did not include all job titles. Therefore, we matched missing job titles to a similar existing job title and exposure in the JEM. This was done by consensus preceded by independent matching by two occupational medicine experts. We dichotomized JEM variables according to median values to maximize strength of data, and tested other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day).

Statistical methods

Descriptive data are reported as point estimates (either frequency or mean and standard deviation [SD]); the correlation between self-reported physical demand at work and FABQ-W>20 was calculated as Spearman's rank correlation. We used a series of multivariate logistic regression models to investigate each measure from the Lower Body JEM separately. The models investigated the association between dichotomized sick leave due to LBP ≥ 8 days compared to 1-7 days during the previous year (outcome) and either self-reported physical demand at work, fear avoidance, or objective workload (JEM), all adjusted for age and sex. Analyses of the modifying effects of

specific independent variables on effect of self-reported exposure were performed by adding an interaction term between the objective (JEM) and self-reported exposure (e.g. FABQ-W and self-reported physically demanding work) to the regression model. Statistical analyses for descriptive data were done using SAS version 9.2 (SAS Institute IC, Cary, NC, USA) and regression analysis were done using R® v 3.2.2 (R: A Language and Environment for Statistical Computing, R Foundation for Statistical Computing, Vienna, Austria, 2016, https://www.R-project.org). All analyses used a significance level of 0.05.

Patient and public involvement

Patients or the general public were not involved in the design or development of the study.

RESULTS

Participants

Based on the telephone interview 274 participants out of 573 interviewed were excluded, mainly due to not having a current episode of LBP or not having a physically demanding job. Of the 326 enrolled participants 305 participants came to the first visit and were included in the study, see Figure 1. A total of 55 job titles (48 among male and 24 among women) were represented and 41 participants were reassigned a new job title with similar exposure group due to lacking presence in the JEM (data not shown).

Descriptive data

Participant characteristics are shown in table 1.

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1

2

3

4

Table 1 Characteristics of the participants (N=**305**)

			Self-reported physical demand				
	Total		Very demanding		Demanding		P-value
	305	(100%)	144	(47.2%)	161	(52.8%)	
Age, years, Mean ±SD	45.5	± 10.3	47.5	±9.8	43.3	±10.3	<0.001*
Males, n (%)	206	(67.5%)	96	(66.7%)	110	(68.3%)	0.853[+]
Current Smoking							0.004[+]
Yes, n (%)	112	(36.7%)	63	(43.8%)	49	(30,43%)	
No, n (%)	193	(63.3%)	81	(56.3%)	112	(69.6%)	
BMI (kg/m^2)	26.9	± 4.2	27.2	±4.1	26.7	±4.4	0.278*
Actual sick leave due to LBP, n (%)	34	(11.2%)	23	(16.0%)	11	(6.8%)	0.020[+]
Sick leave due to LBP last year							0.069[+]
1-7 days, n (%)	168	(55.1%)	69	(47.9%)	99	(61.5%)	
8-30 days, n (%)	104	(34.1%)	104	(38.9%)	56	(29.8%)	
31-90 days, n (%)	25	(8.2%)	13	(9.0%)	12	(7.5%)	
>90 days, n (%)	8	(2.6%)	2	(4.2%)	6	(1.2%)	
Physical demanding workloads							
Standing/walking > 5.44 hours/day, n (%)	147	(48.2%)	69	(47.9%)	78	(48.5%)	0.328[+]
Lifting >650 kg/day, n (%)	148	(48.5%)	77	(53.5%)	71	(44.1%)	0.128[+]
Number of heavy lifts > 7.7 times/day, n (%)	145	(47.5%)	75	(52.1%)	70	(43.5%)	0.165[+]
Clinical symptoms							0.468[+]
LBP, n (%)	170	(55.7%)	85	(59.0%)	85	(52.8%)	
LBP and + additional sciatica, n (%)	86	(28.2%)	36	(25.0%)	50	(31.1%)	
LBP and + additional radiating pain, n (%)	49	(16.1%)	23	(16.0%)	26	(16.2%)	
Primary diagnosis[¤]							0.498[+]
Spondylosis, n (%)	155	(50.8%)	68	(47.2%)	87	(54.0%)	
Herniated disc, n (%)	48	(15.7%)	23	(16.0%)	25	(15.5%)	
Spondylolisthesis, n (%)	23	(7.5%)	11	(7.6%)	12	(7.5%)	
Spinal stenosis, n (%)	12	(3.9%)	4	(2.8%)	8	(5.0%)	
Unspecific LBP, n (%)	46	(15.1%)	24	(16.7%)	22	(13.7%)	
Spondyloarthritis, n (%)	13	(4.3%)	9	(6.3%)	4	(2.5%)	
Other, n (%)	8	(2.6%)	5	(3.5%)	3	(1.9%)	
Current job[#]							0.816[+]
Disco 1, 2: professionals and high educated, n (%)	21	(6.9%)	9	(6.3%)	12	(7.5%)	
Disco 3, 4, 5: office, teaching and nursing, n (%)	99	(33.8%)	47	(32.6%)	56	(34.8%)	
Disco 6, 7, 8, 9: blue collar, n (%)	181	(59.3%)	88	(61.1%)	93	(57.7%)	
Pain intensity (VAS 0-10)							
Average last 4 weeks, Mean ±SD	5.6	± 1.9	5.3	±1.9	5.99	±1.9	0.002*
Actual, Mean ±SD	4.5	± 2.1	4.3	±2.1	4.7	±2.0	0.105*

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Highest intensity last 4 weeks, Mean ±SD	7.1	± 2.0	6.75	±2.0	7.5	±2.0	<0.001*
Fear Avoidance Beliefs							<0.001+
Low (0-20), n (%)	83	(27.2%)	23	(16.0%)	60	(37.3%)	
High (21-42), n (%)	222	(72.8%)	121	(84.0%)	101	(62.7%)	
(0-42), Mean ±SD	25.0	± 7.4	22.6	±7.03	27.8	±6.9	<0.001*

¤Based on symptoms, clinical examination and MRI. *t-test, +X^2-test, # Danish version of the International Standard Classification of Occupations
Values are percentages of participants or mean and SDs.
BMI; body mass index, VAS; visual analog scale, FABQ; Fear Avoidance Beliefs Questionnaire. LBP; low back pain

Of the included participants 47.2% indicated having a very physically demanding job and 52.8% a physically demanding job. Blue collar workers amounted to 59.3% of the participants, 33.8% were in teaching, office work or nursing and 6.9% were professionals and higher educated.

Overall there was a low rate of sick leave due to LBP with 89.2% participants having less than one month of sick leave during the last 12 months.

Participants with a self-reported very physically demanding job were slightly, but significantly older compared to participants who only reported their job demanding. There were no significant differences regarding sex, BMI, JEM or educational level.

Risk factors for sick leave due to LBP

High self-reported physical demand and high fear avoidance beliefs (FABQ-W>20) were both significantly associated with sick leave due to LBP ≥ 8 days per year with OR 1.75 (95% CI 1.10-2.75) and 2.75 (95% CI 1.61-4.84), respectively. After adjustment for age and sex, there was still a strong association, see table 2.

Table 2: Crude and adjusted odds risk ratio for sick leave due to LBP according to self-rated physical demand, fear avoidance behavior and physical demanding workloads, respectively.

	Unadjusted OR (95%CI)	P-value	Adjusted* OR (95%CI)	P-value
Self-rated physical demand				
Demanding	1		-	-
Very demanding	1.75 (1.10-2.75)	0.018	1.60(1.00-2.56)	0.050
Fear avoidance beliefs				

FABQ-W≤20+	1		-	-
FABQ-W>20+	2.75 (1.61-4.84)	<0.001	2.67 (1.55-4.73)	0.001
Physical demanding workloads				
Standing/walking > 5.44 hours/day	0.85 (0.5-1.34)	0.485	0.84 (0.53-1.33)	0.462
Lifting >650 kg/day	1.41 (0.90-2.23)	0.134	1.38 (0.87-2.18)	0.174
Number of heavy lifts > 7.7 times/day	1.60 (1.02-2.53)	0.041	1.57 (0.99-2.50)	0.056

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

There was a positive association of lifting loads over 20 kg more than 7.7 times per day measured by JEM, which was borderline statistically significant after adjustment. None of the other physical workloads were significantly associated with sick leave due to LBP. There was very low exposure to kneeling and whole-body vibration and thus these exposures were not included in the analyses.

Interactions

No significant modifying effect of physical demanding workloads (standing/walking >5.44 hours/day, total kg lifted > 650 kg/day and lifting loads over 20kg more than 7.7 times per day) on the association between self-reported physical demand and sick leave due to LBP was found (table 3).

Table 3: Modifying effects of specific independent exposures on the effect of self-reported physical demand on sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Fear avoidance beliefs		
FABQ-W>20+	1.27 (0.39-4.32)	0.70
Physical demanding workloads		
Standing/walking > 5.44 hours/day	0.74 (0.29-1.86)	0.52
Standing/walking > 6 hours/day	1.21 (0.37-4.02)	0.76
Lifting >650 kg/day	0.63 (0.24-1.59)	0.32
Lifting >1000 kg/day	0.99 (0.37-2.64)	0.97
Number of heavy lifts > 7.7 times/day	0.75 (0.29-1.90)	0.4
Number of heavy lifts > 15 times/day	1.09 (0.28-4.39)	0.90

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

We repeated the analysis with other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day) but this did not change the results.

Similar results of no modification effect of JEM variables were found between FABQ-W>20 and sick leave due to LBP, table 4.

Table 4: Modifying effects of specific independent exposures on the effect of fear avoidance beliefs on sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Physical demanding workloads		
Standing/walking > 5.44 hours/day	0.77 (0.25-2.40)	0.65
Standing/walking > 6 hours/day	1.16 (0.30-5.29)	0.83
Lifting >650 kg/day	0.88 (0.29-2.69)	0.83
Lifting >1000 kg/day	1.11 (0.34-3.82)	0.87
Number of heavy lifts > 7.7 times/day	1.04 (0.34-3.16)	0.95
Number of heavy lifts > 15 times/day	1.38 (0.30-6.70)	0.68

* Adjusted for sex and age,

There was a relatively poor correlation between self-reported physical demand and high fear avoidance (FABQ-W>20) (r= 0.29, P<0.0001). No correlation was found between self-reported physical demand and total kg lifted (r= -0.05, P=0.345), standing/walking time (r= 0.07, P=0.254) or lifting loads over 20kg (r= -0.05, P=0.349).

DISCUSSION

Key results

In this study, self-reported high physical demand at work and high fear avoidance were associated with sick leave due to LBP. Standing/walking time and total number of kg lifted in one day had no effect on sick leave due to LBP, whereas lifting over 20 kg several times a day (7.7 times per day) may have an importance. To some surprise, there was no modifying effect of adding these

independent expert exposure assessments on workload on the found association between self-reported high physical demand at work/ high fear avoidance and sick leave.

Our results confirmed the hypothesis that main risk factors for sick leave due to LBP were self-reported very physically demanding work and high fear avoidance and to a lesser degree "objective" intensity of specific types of physical workloads. The poor correlation between JEM variables and self-reported physical demand supports this conclusion.

Limitations

Some limitations of the study need to be considered. The study is based on cross-sectional baseline data from a randomized controlled trial with the aim of retaining participants with physically demanding work and LBP in their job. As a result, the trial included only participants with self-reported physically demanding or very demanding work and expressed concern about their ability to maintain their current job. The resulting fear avoidance score and self-reported physical demands may consequently have been inflated probably resulting in a lacking contrast among the participants and therefore between the groups. An association was found and the estimate is probably therefore conservative. Use of JEMs entails risk of misclassification of exposure.[23] People with the same job title may have very different exposure to physical workloads and using expert assessment of exposures at the occupational level may therefore miss potentially large individual differences and peak exposures. Another limitation is the dichotomizing of the JEM based physical workload exposures and of the FABQ-W. No gold standard exists regarding cut-off values for either. Several different methods have been proposed and used, and none have been validated.[8] We used FABQ-W score at 20 or less for low fear avoidance as proposed by others[8,21] and medians for JEM based physical workload exposures. This may also increase the risk of misclassification and therefore underestimate differences between groups. Self-reported sick leave is sensitive to recall

bias. However, a meta-analysis has found reasonable rank order convergence with record-based data[24], for which reason we trust in the outcome data. This study includes a selected group of participants with physically demanding work. We did not adjust for socioeconomic status due to risk for over-adjusting since workers with lower socioeconomic status tend to have more physically demanding work.[25] Sample size might explain the wide confidence intervals on all modifications by JEM, but since all odds-ratios are close to 1, it is hardly a question of lack of strength in the data. Neither was there a problem with data contrast in exposure variables of the JEM.

Self-reported workload exposures are often used as exposure variable, although it may have a validity problem, as individuals with musculoskeletal complaints tend to overestimate their exposures.[14] In this study, we have overcome this problem by using a job exposure matrix in combination with perceived self-reported physical demand.

Interpretation

To some surprise the participants reporting work as very physically demanding also had the lowest mean fear avoidance, lowest current and average pain intensity and were more seldom smokers than participants reporting work as physically demanding. The low correlation between self-reported physical demand and JEM variables and no modifying effect of JEM variables indicates that self-reported physical demand might be a more independent risk factor than expected. This may be an expression of the participants assessment of their own physical work capacity with LBP or another work-related factor that we have not investigated. Due to the exclusion of participants with low self-reported physical demand we were unable to explore this further.

The Lower Body JEM have recently been used on a large general working population and found a exposure-response relation between ton- lifting- and kneeling years and all-cause long term sick leave.[26] The contrast with our results may be due to different definitions of exposure (medians vs

ton-/lifting-years), older but healthier population and long term versus relatively short-term sick leave.

Participants with different duration of LBP have different prognostic outcome. Thus it is shown that acute and chronic LBP and high FAB are less associated with poor outcome than subacute LBP, were there has been found a positive association between sick leave and high fear avoidance.[8,27] Our results are in line with these results although many of our participants in addition to a subacute period of LBP also had a longer history of LBP.

Self-reported physical workloads and sick leave have been found to be associated.[11–13] Recently, 5076 employed wage earners in Denmark have been investigated and self-assessed life-long hard physical work and in particular lifting/carrying tasks was found to be associated with all-cause long-term sick leave.[28] Similar results was found in shipyard workers, where borderline significant association between sick leave due to LBP and self-reported physical work factors was found.[29] Our results are in line with these findings, although we used other exposure definitions. In contrast, a longitudinal study with 6 months follow-up among 407 industrial workers used high perceived physical workload as exposure variable, but found no association with sick leave due to LPB.[30] This result can however be explained by low number of workers reporting sick leave or having LBP.

In a large review regarding acute LBP and sick leave Steenstra et al found strong evidence for heavy work, in various definitions, as a predictor for duration of sick leave.[31] A later review by the same author regarding patients with subacute and chronic LBP, a population more similar to ours, concluded insufficient to moderate evidence for an association with physical demands at work.[25]

In a longitudinal study with video-documented physical exposures lifting, trunk flexion and rotation increased the risk of sick leave due to LBP.[32] In our study, we did not use objective measurements but instead a JEM, which may explain the difference between the results because of the risk of misclassification of exposure by using JEM. This illustrates the importance of further large studies with objective measures of physical workload and prospective designs.

CONCLUSION

Our data suggest that self-reported high physical demand at work and high fear avoidance are associated with sick leave due to LBP in individuals with physically demanding jobs. We found no association between sick leave due to LBP and high physical workloads, except for number of heavy lifts measured by JEM. Interestingly, the high physical workloads did not modify the risk of sick leave in participants who rate their work as very demanding or with high fear avoidance scores. The poor correlation between JEM variables and self-reported physical demand supports the conclusion, that occupational interventions to reduce sick leave due to LBP should focus more on those who rate their work as very physically demanding and with high fear avoidance beliefs about work, and less on identification of individuals with the objectively highest physical workload.

Footnotes

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Contributorship statement: JAP, LK, BBH, LMB, EMF, AIK: Study concept and design. JAP, BBH, LMB, AIK: Data acquisition. JAP, BBH, EMF: Statistical analysis. JAP, LK, BBH, LMB, EMF, MB, PH, HB, AIK: Analysis and interpretation of data and critical revision and approval of

the final manuscript. JAP: Drafting of the manuscript. All authors reviewed drafts and approved the final manuscript.

Data sharing statement: Research records and data collection are obtained according to the Danish Personal Data Act (DPA) guidelines and any extra data is available upon request under the terms of DPA and European GDPA. The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. Full dataset to replicate the main analysis is available from the corresponding author on reasonable request

Competing interests: there are no competing interests for any author.

Figure legend: Figure 1: Flow chart for the actual study in the GoBack trial.

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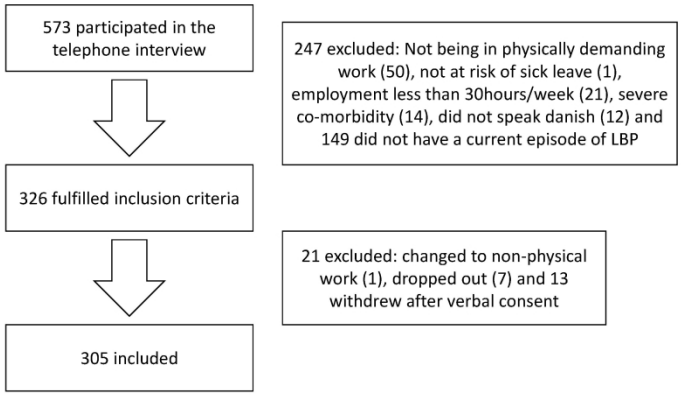

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	7-8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	Figure1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9

		(*b*) Report category boundaries when continuous variables were categorized	tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Physical demand at work and sick leave due to low back pain - a cross sectional study

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Abstract

Objectives: To investigate if self-reported high physical demand at work, objective physical workload using a job exposure matrix (JEM) and fear avoidance beliefs are risk factors for sick leave in persons with low back pain (LBP). Secondly, to investigate if the effects of fear avoidance and self-reported high physical demand at work on sick leave are modified by the objective physical workloads.

Settings: Participants were recruited from general practice and by advertisement in a local newspaper.

Participants: 305 participants with LBP, a current period of 2 to 4 weeks and self-reported difficulty in maintaining physically demanding jobs due to LBP were interviewed, clinically examined and had an MRI at baseline.

Main outcome measures: Independent variables were high fear avoidance**,** self-reported high physical demand at work and objective measures of physical workloads (JEM). Outcome was self-reported sick leave due to LBP in the previous year. Logistic regression and tests for interaction were used to identify risk factors and modifiers for the association with self-reported sick leave.

Results: Self-reported physically demanding work and high fear avoidance were significantly associated with prior sick leave due to LBP with OR 1.75 95%CI (1.10-2.75) and 2.75 95%CI (1.61-4.84) respectively. No objective physical workloads had significant associations. There was no modifying effect of objective physical workloads on the association between self-reported physical demand at work/ high fear avoidance and sick leave.

Conclusions: Occupational interventions to reduce sick leave due to LBP should focus more on those with high self-reported physical demands and high fear avoidance, and less on individuals with the objectively highest physical workload.

Trial registration: The GoBack trial was registered with ClinicalTrials.gov (identifier: NCT02015572) on 29 November 2013

Strength and limitations of this study.

- By using fear avoidance score and self-reported workload together with a job exposure matrix in the investigation of an association with sick leave, the validity problem with self-reported exposures has been reduced
- The study population consisted of workers with low back pain and a physically demanding work, which is a clinically relevant sample of participants.
- Workers with low back pain but no self-reported physically demanding work were not included in the study with risk of lacking contrast among the included participants and thus risk of underestimation of associations.
- Use of job exposure matrices and dichotomizing of the exposure data without a golden standard regarding cut-off values entails risk of misclassification of exposure.

INTRODUCTION

Background

Low back pain (LBP) is a common musculoskeletal disorder and is one of the leading causes of disability for the working population. [1,2] In Denmark, back pain is estimated to accumulate 4.8 billion DKr in annual loss of productivity.[3]

The risk factors for developing LBP are believed to be a complex combination of both mechanical and physiological factors, and psychological, social and cultural factors.[4] Systematic reviews have concluded that no single intervention is likely to be effective to prevent LBP, due to its multidimensional nature.[5–7]

Psychological factors such as high fear avoidance beliefs (FAB) has proven to be an important prognostic factor for poor outcome in patients with nonspecific LBP[8] and as such have a predictive effect on sick leave. [9,10] FAB is believed to influence the perception of pain resulting in catastrophizing, fear and avoidance of physical activities. This leads to a vicious cycle of fear avoidance behaviour, physical deterioration and social isolation – factors which may affect the ability to stay in job.[10]

Self-reported workload exposures have been investigated as risk factors for LBP in the majority of studies [11–13] despite the fact, that self-reported workload exposures may entail a validity problem as individuals with musculoskeletal complaints tend to overestimate their exposures.[14], A job exposure matrix (JEM) is a classification system linking occupation and industry titles with job-related exposures.[15] This could be more accurate estimating the real exposure of physical demands because of reduction misclassification of exposure. However, we do not know if a JEM is better at predicting risk of sick leave. JEMs have been shown to be an independent and valid

measurement of physical demands in patients with primary hip and knee osteoarthritis [16], may be useful in the assessment of exposure for LBP patients, and be associated with sick leave.

Objective

The objective of the study was 1) to investigate to what degree self-reported high physical demand at work, physical workload using the job exposure matrix and fear avoidance beliefs are associated with sick leave in a group of persons with low back pain and 2) if the association between fear avoidance or self-reported high physical demand at work and sick leave is modified by the objective measures of physical workloads.

METHODS

Design and Ethics

The study was based on cross-sectional baseline data from a randomized controlled trial (the GoBack trial, NCT02015572) [17] and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines – the STROBE.[18] All participants gave written informed consent before enrolment and the study was approved by the local ethics committee (H-3-2013-161) and the Danish Data Protection Agency ((DPA approval number 2014-41-2673).

Participants and setting

Participants between 18 and 65 years of age with a current episode of 2 to 4 weeks of LBP and a self-reported physically demanding job were recruited from general practice, the outpatient clinic of the Department of Rheumatology, Frederiksberg Hospital, Denmark and by advertisement in a local newspaper. Potential participants were interviewed by telephone and screened for inclusion. Participants responded to “How physically demanding is your current job?” Response categories

were: "Very demanding, demanding, not very demanding, not at all demanding." Only those responding demanding or very demanding were included. Furthermore, the participants needed to express concerns about the ability to maintain their current job (yes/no) and they had to have current employment for at least 30 hours/week. Individuals with pregnancy, other severe somatic or psychiatric disease, cancer or metastatic disease, severe co-morbidity, treatment or referral to outside providers (for example surgery) or contraindications for having a conventional MRI were not included.

Variables

At the first visit (baseline) participants filled in a battery of questionnaires on a validated touch screen[19], underwent a physical examination and an MRI. The questionnaires investigated demographic information, comorbidity, job-category, previous history of LBP, physically demanding work, leisure-time, physical activity, psychosocial work environment, general health status, history of work-related factors, work ability, back-specific disability, fear avoidance beliefs, pain score and sick leave due to LBP. Diagnosis was based on symptoms, clinical examination and MRI.

Sick leave due to LBP was recorded by answering the following questions at baseline: "how many days of sick leave have you had due to LBP in the previous year?" Categorized as short (1-7 days), medium (8-30 days), long (31-90 days), very long (over 90 days) or every day. Sick leave due to LBP was then dichotomized as low (1-7 days/year) and high (≥8days/year) due to overall low sick leave among the participants.

Fear avoidance beliefs was assessed with the 16-item Fear-Avoidance Beliefs Questionnaire (FABQ).[20] FABQ-W is the sum of seven items (score range 0-42 points) with each item scored

on a seven-point Likert scale from strongly disagree (0-points) to strongly agree (6-points). We defined high fear avoidance beliefs as FABQ-W>20 points.[21]

Physically demanding work was evaluated both by self-report (having a very demanding or having a demanding current job) and with the use of the Lower Body Job Exposure Matrix (JEM).[16]

Job titles from the baseline questionnaires were transformed into an occupational title in the Danish version of the International Standard Classification of Occupations (D-ISCO-88).[22] The JEM consisted of 168 D-ISCO codes which were divided into 121 job groups. Occupational medicine experts assessed physical exposures during a working day and estimated time sitting, time standing/walking, time with whole body vibration, time kneeling, and lifting (cumulated weight and number of heavy lifts>20 kg) in different jobs. The JEM did not include all job titles. Therefore, we matched missing job titles to a similar existing job title and exposure in the JEM. This was done by consensus preceded by independent matching by two occupational medicine experts. We dichotomized JEM variables according to median values to maximize strength of data and tested other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day).

Statistical methods

Descriptive data are reported as point estimates (either frequency or mean and standard deviation [SD]); the correlation between self-reported physical demand at work and FABQ-W>20 was calculated as Spearman's rank correlation. We used a series of multivariate logistic regression models to investigate each measure from the Lower Body JEM separately. The models investigated the association between dichotomized sick leave due to LBP ≥ 8 days compared to 1-7 days during the previous year (outcome) and either self-reported physical demand at work, fear avoidance, or objective workload (JEM), all adjusted for age and sex. Analyses of the modifying effects of

specific independent variables on effect of self-reported exposure were performed by adding an interaction term between the objective (JEM) and self-reported exposure (e.g. FABQ-W and self-reported physically demanding work) to the regression model. Statistical analyses for descriptive data were done using SAS version 9.2 (SAS Institute IC, Cary, NC, USA) and regression analysis were done using R® v 3.2.2 (R: A Language and Environment for Statistical Computing, R Foundation for Statistical Computing, Vienna, Austria, 2016, https://www.R-project.org). All analyses used a significance level of 0.05.

Patient and public involvement

Patients or the general public were not involved in the design or development of the study.

RESULTS

Participants

Based on the telephone interview 274 participants out of 573 interviewed were excluded, mainly due to not having a current episode of LBP or not having a physically demanding job. Of the 326 enrolled participants 305 participants came to the first visit and were included in the study, see Figure 1. A total of 55 job titles (48 among male and 24 among women) were represented and 41 participants were reassigned a new job title with similar exposure group due to lacking presence in the JEM (data not shown).

Descriptive data

Participant characteristics are shown in table 1.

Table 1 Characteristics of the participants (N=**305**)

			Self-reported physical demand				
	Total		Very demanding		Demanding		P-value
	305	(100%)	144	(47.2%)	161	(52.8%)	
Age, years, Mean ±SD	45.5	± 10.3	47.5	±9.8	43.3	±10.3	<0.001*
Males, n (%)	206	(67.5%)	96	(66.7%)	110	(68.3%)	0.853+
Current Smoking							0.004+
Yes, n (%)	112	(36.7%)	63	(43.8%)	49	(30,43%)	
No, n (%)	193	(63.3%)	81	(56.3%)	112	(69.6%)	
BMI (kg/m^2)	26.9	± 4.2	27.2	±4.1	26.7	±4.4	0.278*
Actual sick leave due to LBP, n (%)	34	(11.2%)	23	(16.0%)	11	(6.8%)	0.020+
Sick leave due to LBP last year							0.069+
1-7 days, n (%)	168	(55.1%)	69	(47.9%)	99	(61.5%)	
8-30 days, n (%)	104	(34.1%)	104	(38.9%)	56	(29.8%)	
31-90 days, n (%)	25	(8.2%)	13	(9.0%)	12	(7.5%)	
>90 days, n (%)	8	(2.6%)	2	(4.2%)	6	(1.2%)	
Physical demanding workloads							
Standing/walking > 5.44 hours/day, n (%)	147	(48.2%)	69	(47.9%)	78	(48.5%)	0.328+
Lifting >650 kg/day, n (%)	148	(48.5%)	77	(53.5%)	71	(44.1%)	0.128+
Number of heavy lifts > 7.7 times/day, n (%)	145	(47.5%)	75	(52.1%)	70	(43.5%)	0.165+
Clinical symptoms							0.468+
LBP, n (%)	170	(55.7%)	85	(59.0%)	85	(52.8%)	
LBP and + additional sciatica, n (%)	86	(28.2%)	36	(25.0%)	50	(31.1%)	
LBP and + additional radiating pain, n (%)	49	(16.1%)	23	(16.0%)	26	(16.2%)	
Primary diagnosis¤							0.498+
Spondylosis, n (%)	155	(50.8%)	68	(47.2%)	87	(54.0%)	
Herniated disc, n (%)	48	(15.7%)	23	(16.0%)	25	(15.5%)	
Spondylolisthesis, n (%)	23	(7.5%)	11	(7.6%)	12	(7.5%)	
Spinal stenosis, n (%)	12	(3.9%)	4	(2.8%)	8	(5.0%)	
Unspecific LBP, n (%)	46	(15.1%)	24	(16.7%)	22	(13.7%)	
Spondyloarthritis, n (%)	13	(4.3%)	9	(6.3%)	4	(2.5%)	
Other, n (%)	8	(2.6%)	5	(3.5%)	3	(1.9%)	
Current job#							0.816+
Disco 1, 2: professionals and high educated, n (%)	21	(6.9%)	9	(6.3%)	12	(7.5%)	
Disco 3, 4, 5: office, teaching and nursing, n (%)	99	(33.8%)	47	(32.6%)	56	(34.8%)	
Disco 6, 7, 8, 9: blue collar, n (%)	181	(59.3%)	88	(61.1%)	93	(57.7%)	
Pain intensity (VAS 0-10)							
Average last 4 weeks, Mean ±SD	5.6	± 1.9	5.3	±1.9	5.99	±1.9	0.002*
Actual, Mean ±SD	4.5	± 2.1	4.3	±2.1	4.7	±2.0	0.105*
Highest intensity last 4 weeks, Mean ±SD	7.1	± 2.0	6.75	±2.0	7.5	±2.0	<0.001*
Fear Avoidance Beliefs							<0.001+
Low (0-20), n (%)	83	(27.2%)	23	(16.0%)	60	(37.3%)	
High (21-42), n (%)	222	(72.8%)	121	(84.0%)	101	(62.7%)	
(0-42), Mean ±SD	25.0	± 7.4	22.6	±7.03	27.8	±6.9	<0.001*

¤Based on symptoms, clinical examination and MRI. *t-test, +X^2-test, # Danish version of the International Standard Classification of Occupations

Values are percentages of participants or mean and SDs.

BMI; body mass index, VAS; visual analog scale, FABQ; Fear Avoidance Beliefs Questionnaire. LBP; low back pain

1

Overall there was a low rate of sick leave due to LBP with 89.2% participants having less than one month of sick leave during the last 12 months.

Participants reporting work as very physically demanding also had the lowest mean FAB, lowest current and average pain intensity and were more seldom smokers than participants reporting work as physically demanding.

Participants with a self-reported very physically demanding job were slightly, but significantly older compared to participants who only reported their job demanding. There were no significant differences regarding sex, BMI, JEM or educational level.

Factors associated with sick leave due to LBP

High self-reported physical demand and high fear avoidance beliefs (FABQ-W>20) were both significantly associated with sick leave due to LBP ≥ 8 days per year with OR 1.75 (95% CI 1.10-2.75) and 2.75 (95% CI 1.61-4.84), respectively. After adjustment for age and sex, there was still a strong association, see table 2.

Table 2: Crude and adjusted odds ratio for sick leave due to LBP according to self-rated physical demand, fear avoidance beliefs and physical demanding workloads, respectively.

	Unadjusted OR (95%CI)	P-value	Adjusted* OR (95%CI)	P-value
Self-rated physical demand				
Demanding	1		-	-
Very demanding	1.75 (1.10-2.75)	0.018	1.60(1.00-2.56)	0.050
Fear avoidance beliefs				
FABQ-W≤20+	1		-	-
FABQ-W>20+	2.75 (1.61-4.84)	<0.001	2.67 (1.55-4.73)	0.001
Physical demanding workloads				
Standing/walking > 5.44 hours/day	0.85 (0.5-1.34)	0.485	0.84 (0.53-1.33)	0.462
Lifting >650 kg/day	1.41 (0.90-2.23)	0.134	1.38 (0.87-2.18)	0.174
Number of heavy lifts > 7.7 times/day	1.60 (1.02-2.53)	0.041	1.57 (0.99-2.50)	0.056

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

There was a positive association of lifting loads over 20 kg more than 7.7 times per day measured by JEM, which was borderline statistically significant after adjustment. None of the other physical workloads were significantly associated with sick leave due to LBP. There was very low exposure to kneeling and whole-body vibration and thus these exposures were not included in the analyses.

Interactions

Physical demanding workloads did not modify the association between self-reported physical demand and sick leave due to LBP (table 3).

Table 3: Modifying effects of specific independent exposures on the association between self-reported physical demand and sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Fear avoidance beliefs		
FABQ-W>20+	1.27 (0.39-4.32)	0.70
Physical demanding workloads		
Standing/walking > 5.44 hours/day	0.74 (0.29-1.86)	0.52
Standing/walking > 6 hours/day	1.21 (0.37-4.02)	0.76
Lifting >650 kg/day	0.63 (0.24-1.59)	0.32
Lifting >1000 kg/day	0.99 (0.37-2.64)	0.97
Number of heavy lifts > 7.7 times/day	0.75 (0.29-1.90)	0.4
Number of heavy lifts > 15 times/day	1.09 (0.28-4.39)	0.90

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

We repeated the analysis with other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day) but this did not change the results.

Similar results of no modification effect of JEM variables were found between FABQ-W>20 and sick leave due to LBP, table 4.

Sick leave due to low back pain.

Table 4: Modifying effects of specific independent exposures on the association between fear avoidance beliefs and sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Physical demanding workloads		
Standing/walking > 5.44 hours/day	0.77 (0.25-2.40)	0.65
Standing/walking > 6 hours/day	1.16 (0.30-5.29)	0.83
Lifting >650 kg/day	0.88 (0.29-2.69)	0.83
Lifting >1000 kg/day	1.11 (0.34-3.82)	0.87
Number of heavy lifts > 7.7 times/day	1.04 (0.34-3.16)	0.95
Number of heavy lifts > 15 times/day	1.38 (0.30-6.70)	0.68

* Adjusted for sex and age,

There was a relatively poor correlation between self-reported physical demand and high fear avoidance beliefs (FABQ-W>20) (r= 0.29, P<0.0001). No correlation was found between self-reported physical demand and total kg lifted (r= -0.05, P=0.345), standing/walking time (r= 0.07, P=0.254) or lifting loads over 20kg (r= -0.05, P=0.349).

DISCUSSION

Key results

In this study, self-reported high physical demand at work and high FAB were associated with sick leave due to LBP. Standing/walking time and total number of kg lifted in one day had no association with sick leave due to LBP, whereas lifting over 20 kg several times a day may be associated. To some surprise, independent expert exposure assessments of workload did not modify the found association between self-reported high physical demand at work/ high FAB and sick leave.

Our results confirmed the hypothesis that sick leave due to LBP were associated with self-reported very physically demanding work and high FAB and to a lesser degree with “objective” intensity of specific types of physical workloads. The poor correlation between JEM variables and self-reported physical demand supports this conclusion.

Limitations

The study is based on cross-sectional baseline data from a randomized controlled trial with the aim of retaining participants with physically demanding work and LBP in their job. This limits our ability to investigate causality. The trial included only participants with self-reported physically demanding or very demanding work and concern about their ability to maintain their current job. The resulting FAB score and self-reported physical demands may consequently have been inflated and can result in a lacking contrast among the participants and therefore between the groups. An association was found, and the estimate is probably conservative. Furthermore, use of JEMs entails risk of misclassification of exposure,[23] as people with the same job title may have different exposure to physical workloads and using expert assessment of exposures at the occupational level may therefore miss potentially large individual differences and peak exposures. This can also lead to conservative estimates of associations. Another limitation is the dichotomizing of the JEM based physical workload exposures and of the FABQ-W. No gold standard exists regarding cut-off values for either. Several different methods have been proposed and used, and none have been validated.[8] We used FABQ-W score at 20 or less for low FAB as proposed by others[8,21] and medians for JEM based physical workload exposures. This may also increase the risk of misclassification and therefore underestimate differences between groups. Self-reported sick leave is sensitive to recall bias. However, a meta-analysis has found reasonable rank order convergence with record-based data[24], for which reason we trust in the outcome data. This study includes a selected group of participants with physically demanding work. We did not adjust for socioeconomic status due to risk for over-adjusting since workers with lower socioeconomic status tend to have more physically demanding work.[25] Sample size might explain the wide confidence intervals on all modifications by JEM, but since all odds-ratios are close to 1, it is hardly a question of lack of strength in the data. Neither was there a problem with data contrast in exposure variables of the JEM.

Self-reported workload exposures are often used as exposure variable, although it may have a validity problem, as individuals with musculoskeletal complaints tend to overestimate their exposures.[14] In this study, we have overcome this problem by using a job exposure matrix in combination with perceived self-reported physical demand.

Interpretation

The low correlation between self-reported physical demand and JEM variables and no modifying effect of JEM variables indicates that self-reported physical demand might be a more independent risk factor than expected. This may be an expression of the participants assessment of their own physical work capacity with LBP or another work-related factor that we have not investigated. Due to the exclusion of participants with low self-reported physical demand we were unable to explore this further.

The Lower Body JEM have recently been used on a large general working population and found a exposure-response relation between ton- lifting- and kneeling years and all-cause long term sick leave.[26] The contrast with our results may be due to different definitions of exposure (medians vs ton-/lifting-years), older but healthier population and long term versus relatively short-term sick leave.

Participants with different duration of LBP have different prognostic outcome. It has been shown that FAB is associated with poor prognosis in LBP of any duration, but most strongly with subacute LBP.[8,27] Our results confirms the association between high FAB and sick leave although many of our participants in addition to a subacute period of LBP also had a longer history of LBP.

Self-reported physical workloads and sick leave have been found to be associated.[11–13] Recently, 5076 employed wage earners in Denmark have been investigated and self-assessed life-long hard physical work and in particular lifting/carrying tasks was found to be associated with all-cause long-

term sick leave.[28] Similar results was found in shipyard workers, where borderline significant association between sick leave due to LBP and self-reported physical work factors was found.[29] Our results are in line with these findings, although we used other exposure definitions. In contrast, a longitudinal study with 6 months follow-up among 407 industrial workers used high perceived physical workload as exposure variable, but found no association with sick leave due to LPB.[30] This result can however be explained by low number of workers reporting sick leave or having LBP.

In a large review regarding acute LBP and sick leave Steenstra et al found strong evidence for heavy work, in various definitions, as a predictor for duration of sick leave.[31] A later review by the same author regarding patients with subacute and chronic LBP, a population more similar to ours, concluded insufficient to moderate evidence for an association with physical demands at work.[25]

In a longitudinal study with video-documented physical exposures lifting, trunk flexion and rotation increased the risk of sick leave due to LBP.[32] In our study, we did not use objective measurements but instead a JEM, which may explain the difference between the results because of the risk of misclassification of exposure by using JEM. This illustrates the importance of further large studies with objective measures of physical workload and prospective designs.

CONCLUSION

Our study suggests that self-reported high physical demand at work and high fear avoidance are associated with sick leave due to LBP in individuals with physically demanding jobs. We found no association between sick leave due to LBP and high physical workloads, except for number of heavy lifts measured by JEM. Interestingly, the high physical workloads did not modify the associations with sick leave in participants who rate their work as very demanding or with high fear

avoidance scores. The poor correlation between JEM variables and self-reported physical demand indicates, that occupational interventions to reduce sick leave due to LBP should focus more on those with high self-reported physical demands and high fear avoidance, and less on individuals with the objectively highest physical workload.

Footnotes

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Contributorship statement: JAP, LK, BBH, LMB, EMF, AIK: Study concept and design. JAP, BBH, LMB, AIK: Data acquisition. JAP, BBH, EMF: Statistical analysis. JAP, LK, BBH, LMB, EMF, MB, PH, HB, AIK: Analysis and interpretation of data and critical revision and approval of the final manuscript. JAP: Drafting of the manuscript. All authors reviewed drafts and approved the final manuscript.

Data sharing statement: Research records and data collection are obtained according to the Danish Personal Data Act (DPA) guidelines and any extra data is available upon request under the terms of DPA and European GDPA. The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. Full dataset to replicate the main analysis is available from the corresponding author on reasonable request

Competing interests: there are no competing interests for any author.

Figure legend: Figure 1: Flow chart for the actual study in the GoBack trial.

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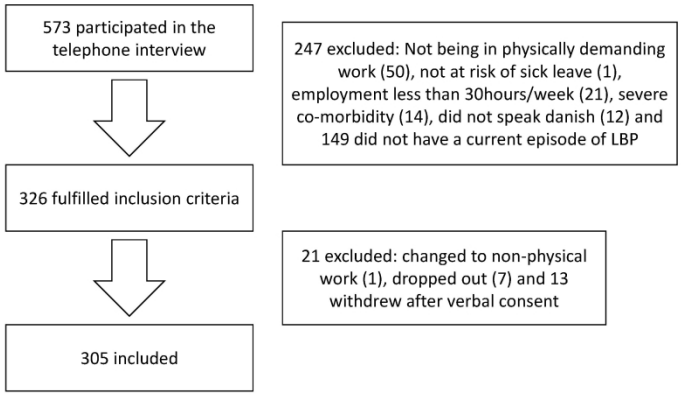

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	7-8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	Figure1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9

		(*b*) Report category boundaries when continuous variables were categorized	tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Physical demand at work and sick leave due to low back pain - a cross sectional study

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Abstract

Objectives: To investigate if self-reported high physical demand at work, objective physical workload using a job exposure matrix (JEM) and fear-avoidance beliefs are associated with reported sick leave in the previous year in persons with low back pain (LBP). Secondly, to investigate if the effects of fear-avoidance and self-reported high physical demand at work on sick leave are modified by the objective physical workloads.

Settings: Participants were recruited from general practice and by advertisement in a local newspaper.

Participants: 305 participants with a current period of 2 to 4 weeks LBP and self-reported difficulty in maintaining physically demanding jobs due to LBP were interviewed, clinically examined and had an MRI at baseline.

Main outcome measures: Independent variables were high fear-avoidance**,** self-reported high physical demand at work and objective measures of physical workloads (JEM). Outcome was self-reported sick leave due to LBP in the previous year. Logistic regression and tests for interaction were used to identify risk factors and modifiers for the association with self-reported sick leave.

Results: Self-reported physically demanding work and high fear-avoidance were significantly associated with prior sick leave due to LBP in the previous year with OR 1.75 95%CI (1.10-2.75) and 2.75 95%CI (1.61-4.84) respectively. No objective physical workloads had significant associations. There was no modifying effect of objective physical workloads on the association between self-reported physical demand at work/ high fear-avoidance and sick leave.

Conclusions: Occupational interventions to reduce sick leave due to LBP may have to focus more on those with high self-reported physical demands and high fear-avoidance, and less on individuals with the objectively highest physical workload.

Trial registration: The GoBack trial was registered with ClinicalTrials.gov (identifier: NCT02015572) on 29 November 2013

Strength and limitations of this study.

- By using fear-avoidance score and self-reported workload together with a job exposure matrix in the investigation of an association with sick leave, the validity problem with self-reported exposures has been reduced
- The study population consisted of workers with low back pain and a physically demanding work, which is a clinically relevant sample of participants.
- Workers with low back pain but no self-reported physically demanding work were not included in the study with risk of lacking contrast among the included participants and thus risk of underestimation of associations.
- Use of job exposure matrices and dichotomizing of the exposure data without a gold standard regarding cut-off values entails risk of misclassification of exposure.

INTRODUCTION

Background

Low back pain (LBP) is a common musculoskeletal disorder and is one of the leading causes of disability for the working population. [1,2] In Denmark, back pain is estimated to accumulate 4.8 billion DKr in annual loss of productivity.[3]

The development of LBP is believed to be caused by a complex combination of both mechanical and physiological factors, and psychological, social and cultural factors.[4] Systematic reviews have concluded that no single intervention is likely to be effective in preventing LBP, due to its multidimensional nature.[5–7]

Psychological factors such as high fear-avoidance beliefs (FAB) have proven to be an important prognostic factor for poor outcome in patients with nonspecific LBP[8] and, as such, have a predictive effect on sick leave. [9,10] FAB are believed to influence the perception of pain resulting in catastrophizing, fear and avoidance of physical activities. This leads to a vicious cycle of fear-avoidance behaviour, physical deterioration and social isolation – factors which may affect the ability to stay in a job.[10]

Self-reported workload exposures have been associated with LBP in the majority of studies [11–13] despite the fact, that self-reported workload exposures may entail a validity problem as individuals with musculoskeletal complaints tend to overestimate their exposures.[14], A job exposure matrix (JEM) is a classification system linking occupation and industry titles with job-related exposures.[15] This could be more accurate in estimating the real exposure of physical demands by reducing misclassification of exposure. However, we do not know if a JEM is better at predicting risk of sick leave. JEMs have been shown to be independent and valid measurements of physical

demands in patients with primary hip and knee osteoarthritis [16], may be useful in the assessment of exposure for LBP patients, and be associated with sick leave.

Objective

The objective of the study was 1) to investigate to what degree self-reported high physical demand at work, physical workload using the job exposure matrix and fear avoidance beliefs are associated with reported sick leave in the previous year in a group of persons with low back pain, and 2) if the association between fear-avoidance or self-reported high physical demand at work and reported sick leave is modified by the objective measures of physical workloads.

METHODS

Design and Ethics

The study was based on cross-sectional baseline data from a randomized controlled trial (the GoBack trial, NCT02015572), [17] and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines – the STROBE.[18] All participants gave written informed consent before enrolment, and the study was approved by the local ethics committee (H-3-2013-161) and the Danish Data Protection Agency ((DPA approval number 2014-41-2673).

Participants and setting

Participants between 18 and 65 years of age with a current episode of 2 to 4 weeks of LBP and a self-reported physically demanding job were recruited from general practice, the outpatient clinic of the Department of Rheumatology, Frederiksberg Hospital, Denmark and by advertisement in a local newspaper. Potential participants were interviewed by telephone and screened for inclusion. Participants responded to “How physically demanding is your current job?” Response categories

were: “Very demanding, demanding, not very demanding, not at all demanding.” Only those responding demanding or very demanding were included. Furthermore, the participants needed to express concern about the ability to maintain their current job (yes/no) and they had to have current employment for at least 30 hours/week. Individuals with pregnancy, severe somatic or psychiatric disease, cancer or metastatic disease, severe co-morbidity, treatment from or referral to outside providers (for example surgery) or contraindications for having a conventional MRI were not included.

Variables

At the first visit (baseline) participants filled in a battery of questionnaires on a validated touch screen[19], underwent a physical examination and an MRI. The questionnaires investigated demographic information, comorbidity, job-category, previous history of LBP, physically demanding work, leisure-time, physical activity, psychosocial work environment, general health status, history of work-related factors, work ability, back-specific disability, fear-avoidance beliefs, pain score and sick leave due to LBP. Diagnosis was based on symptoms, clinical examination and MRI.

Sick leave due to LBP was recorded by answering the following questions at baseline: “How many days of sick leave have you had due to LBP in the previous year?” Categorized as short (1-7 days), medium (8-30 days), long (31-90 days), very long (over 90 days) or every day. Sick leave due to LBP was then dichotomized as low (1-7 days/year) and high (≥8days/year) due to overall low sick leave among the participants.

Fear-avoidance beliefs were assessed with the 16-item Fear-Avoidance Beliefs Questionnaire (FABQ).[20] FABQ-W is the sum of seven items (score range 0-42 points) with each item scored

on a seven-point Likert scale from strongly disagree (0-points) to strongly agree (6-points). We defined high fear-avoidance beliefs as FABQ-W>20 points.[21]

Physically demanding work was evaluated both by self-report (having a very demanding or having a demanding current job) and with the use of the Lower Body Job Exposure Matrix (JEM).[16]

Job titles from the baseline questionnaires were transformed into an occupational title in the Danish version of the International Standard Classification of Occupations (D-ISCO-88).[22] The JEM consisted of 168 D-ISCO codes which were divided into 121 job groups. Occupational medicine experts assessed physical exposures during a working day and estimated time sitting, time standing/walking, time with whole body vibration, time kneeling, and lifting (cumulated weight and number of heavy lifts>20 kg) in different jobs. The JEM did not include all job titles. Therefore, we matched missing job titles to a similar existing job title and exposure in the JEM. This was done by consensus preceded by independent matching by two occupational medicine experts. We dichotomized JEM variables according to median values to maximize strength of data and tested other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day).

Statistical methods

Descriptive data are reported as point estimates (either frequency or mean and standard deviation [SD]); the correlation between self-reported physical demand at work and FABQ-W>20 was calculated as Spearman's rank correlation. We used a series of multivariate logistic regression models to investigate each measure from the Lower Body JEM separately. The models investigated the association between dichotomized sick leave due to LBP ≥ 8 days compared to 1-7 days during the previous year (outcome) and either self-reported physical demand at work, fear-avoidance, or objective workload (JEM), all adjusted for age and sex. Analyses of the modifying effects of

specific independent variables on effect of self-reported exposure were performed by adding an interaction term between the objective (JEM) and self-reported exposure (e.g. FABQ-W and self-reported physically demanding work) to the regression model. Statistical analyses for descriptive data were done using SAS version 9.2 (SAS Institute IC, Cary, NC, USA) and regression analyses was done using R® v 3.2.2 (R: A Language and Environment for Statistical Computing, R Foundation for Statistical Computing, Vienna, Austria, 2016, https://www.R-project.org). All analyses used a significance level of 0.05.

Patient and public involvement

Patients or the general public were not involved in the design or development of the study.

RESULTS

Participants

Based on the telephone interview 274 participants out of 573 interviewed were excluded, mainly due to not having a current episode of LBP or not having a physically demanding job. Of the 326 enrolled participants, 305 participants came to the first visit and were included in the study, see Figure 1. A total of 55 job titles (48 among male and 24 among women) were represented and 41 participants were reassigned a new job title with similar exposure group due to lacking presence in the JEM (data not shown).

Descriptive data

Participant characteristics are shown in table 1.

Table 1 Characteristics of the participants (N=**305**)

			Self-reported physical demand				
	Total		Very demanding		Demanding		P-value
	305	(100%)	144	(47.2%)	161	(52.8%)	
Age, years, Mean ±SD	45.5	± 10.3	47.5	±9.8	43.3	±10.3	<0.001*
Males, n (%)	206	(67.5%)	96	(66.7%)	110	(68.3%)	0.853+
Current Smoking							0.004+
Yes, n (%)	112	(36.7%)	63	(43.8%)	49	(30,43%)	
No, n (%)	193	(63.3%)	81	(56.3%)	112	(69.6%)	
BMI (kg/m^2)	26.9	± 4.2	27.2	±4.1	26.7	±4.4	0.278*
Actual sick leave due to LBP, n (%)	34	(11.2%)	23	(16.0%)	11	(6.8%)	0.020+
Sick leave due to LBP last year							0.069+
1-7 days, n (%)	168	(55.1%)	69	(47.9%)	99	(61.5%)	
8-30 days, n (%)	104	(34.1%)	104	(38.9%)	56	(29.8%)	
31-90 days, n (%)	25	(8.2%)	13	(9.0%)	12	(7.5%)	
>90 days, n (%)	8	(2.6%)	2	(4.2%)	6	(1.2%)	
Physical demanding workloads							
Standing/walking > 5.44 hours/day, n (%)	147	(48.2%)	69	(47.9%)	78	(48.5%)	0.328+
Lifting >650 kg/day, n (%)	148	(48.5%)	77	(53.5%)	71	(44.1%)	0.128+
Number of heavy lifts > 7.7 times/day, n (%)	145	(47.5%)	75	(52.1%)	70	(43.5%)	0.165+
Clinical symptoms							0.468+
LBP, n (%)	170	(55.7%)	85	(59.0%)	85	(52.8%)	
LBP and + additional sciatica, n (%)	86	(28.2%)	36	(25.0%)	50	(31.1%)	
LBP and + additional radiating pain, n (%)	49	(16.1%)	23	(16.0%)	26	(16.2%)	
Primary diagnosis¤							0.498+
Spondylosis, n (%)	155	(50.8%)	68	(47.2%)	87	(54.0%)	
Herniated disc, n (%)	48	(15.7%)	23	(16.0%)	25	(15.5%)	
Spondylolisthesis, n (%)	23	(7.5%)	11	(7.6%)	12	(7.5%)	
Spinal stenosis, n (%)	12	(3.9%)	4	(2.8%)	8	(5.0%)	
Unspecific LBP, n (%)	46	(15.1%)	24	(16.7%)	22	(13.7%)	
Spondyloarthritis, n (%)	13	(4.3%)	9	(6.3%)	4	(2.5%)	
Other, n (%)	8	(2.6%)	5	(3.5%)	3	(1.9%)	
Current job#							0.816+
Disco 1, 2: professionals and highly educated, n (%)	21	(6.9%)	9	(6.3%)	12	(7.5%)	
Disco 3, 4, 5: office, teaching and nursing, n (%)	99	(33.8%)	47	(32.6%)	56	(34.8%)	
Disco 6, 7, 8, 9: blue collar, n (%)	181	(59.3%)	88	(61.1%)	93	(57.7%)	
Pain intensity (VAS 0-10)							
Average last 4 weeks, Mean ±SD	5.6	± 1.9	5.3	±1.9	5.99	±1.9	0.002*
Actual, Mean ±SD	4.5	± 2.1	4.3	±2.1	4.7	±2.0	0.105*
Highest intensity last 4 weeks, Mean ±SD	7.1	± 2.0	6.75	±2.0	7.5	±2.0	<0.001*
Fear-Avoidance Beliefs							<0.001+
Low (0-20), n (%)	83	(27.2%)	23	(16.0%)	60	(37.3%)	
High (21-42), n (%)	222	(72.8%)	121	(84.0%)	101	(62.7%)	
(0-42), Mean ±SD	25.0	± 7.4	22.6	±7.03	27.8	±6.9	<0.001*

¤Based on symptoms, clinical examination and MRI. *t-test, +X^2-test, # Danish version of the International Standard Classification of Occupations

Values are percentages of participants or mean and SDs.

BMI; body mass index, VAS; visual analog scale, FABQ; Fear-Avoidance Beliefs Questionnaire. LBP; low back pain

Overall there was a low rate of sick leave due to LBP with 89.2% participants having less than one month of sick leave during the last 12 months.

Participants with a self-reported very physically demanding job had the lowest mean FAB, lowest current and average pain intensity and were more seldom smokers than participants reporting work as physically demanding.

Participants with a self-reported very physically demanding job were slightly, but significantly older compared to participants who only reported their job as demanding. There were no significant differences regarding sex, BMI, JEM or educational level.

Factors associated with sick leave due to LBP

High self-reported physical demand and high fear-avoidance beliefs (FABQ-W>20) were both significantly associated with sick leave due to LBP ≥ 8 days per year with OR 1.75 (95% CI 1.10-2.75) and 2.75 (95% CI 1.61-4.84), respectively. After adjustment for age and sex, there was still a strong association, see table 2.

Table 2: Crude and adjusted odds ratio for sick leave due to LBP according to self-rated physical demand, fear-avoidance beliefs and physical demanding workloads, respectively.

	Unadjusted OR (95%CI)	P-value	Adjusted* OR (95%CI)	P-value
Self-rated physical demand				
Demanding	1		-	-
Very demanding	1.75 (1.10-2.75)	0.018	1.60(1.00-2.56)	0.050
Fear-avoidance beliefs				
FABQ-W≤20+	1		-	-
FABQ-W>20+	2.75 (1.61-4.84)	<0.001	2.67 (1.55-4.73)	0.001
Physical demanding workloads				
Standing/walking > 5.44 hours/day	0.85 (0.5-1.34)	0.485	0.84 (0.53-1.33)	0.462
Lifting >650 kg/day	1.41 (0.90-2.23)	0.134	1.38 (0.87-2.18)	0.174
Number of heavy lifts > 7.7 times/day	1.60 (1.02-2.53)	0.041	1.57 (0.99-2.50)	0.056

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

There was a positive association of lifting loads over 20 kg more than 7.7 times per day measured by JEM, which was borderline statistically significant after adjustment. None of the other physical workloads were significantly associated with sick leave due to LBP. There was very low exposure to kneeling and whole-body vibration and thus these exposures were not included in the analyses.

Interactions

Physically demanding workloads did not modify the association between self-reported physical demand and sick leave due to LBP (table 3).

Table 3: Modifying effects of specific independent exposures on the association between self-reported physical demand and sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Fear avoidance beliefs		
FABQ-W>20+	1.27 (0.39-4.32)	0.70
Physically demanding workloads		
Standing/walking > 5.44 hours/day	0.74 (0.29-1.86)	0.52
Standing/walking > 6 hours/day	1.21 (0.37-4.02)	0.76
Lifting >650 kg/day	0.63 (0.24-1.59)	0.32
Lifting >1000 kg/day	0.99 (0.37-2.64)	0.97
Number of heavy lifts > 7.7 times/day	0.75 (0.29-1.90)	0.4
Number of heavy lifts > 15 times/day	1.09 (0.28-4.39)	0.90

* Adjusted for sex and age, + Fear-Avoidance Beliefs Questionnaire-in relation to Work

We repeated the analysis with other exposure levels (standing/walking > 6 hours/day, lifting a total of >1000 kg/day and lifting over 20kgs > 15 times/day) but this did not change the results.

Similar results of no modification effect of JEM variables were found between FABQ-W>20 and sick leave due to LBP, table 4.

Sick leave due to low back pain.

Table 4: Modifying effects of specific independent exposures on the association between fear-avoidance beliefs and sick leave due to LBP.

	Interaction OR* (95%CI)	P-value
Physically demanding workloads		
Standing/walking > 5.44 hours/day	0.77 (0.25-2.40)	0.65
Standing/walking > 6 hours/day	1.16 (0.30-5.29)	0.83
Lifting >650 kg/day	0.88 (0.29-2.69)	0.83
Lifting >1000 kg/day	1.11 (0.34-3.82)	0.87
Number of heavy lifts > 7.7 times/day	1.04 (0.34-3.16)	0.95
Number of heavy lifts > 15 times/day	1.38 (0.30-6.70)	0.68

* Adjusted for sex and age,

There was a relatively poor correlation between self-reported physical demand and high fear-avoidance beliefs (FABQ-W>20) (r= 0.29, P<0.0001). No correlation was found between self-reported physical demand and total kg lifted (r= -0.05, P=0.345), standing/walking time (r= 0.07, P=0.254) or lifting loads over 20kg (r= -0.05, P=0.349).

DISCUSSION

Key results

In this study, self-reported high physical demand at work and high FAB were associated with reported sick leave due to LBP in the previous year. Standing/walking time and total number of kg lifted in one day had no association with reported sick leave due to LBP, whereas lifting over 20 kg several times a day may be associated. To some surprise, independent expert exposure assessments of workload did not modify the found association between self-reported high physical demand at work/ high FAB and sick leave.

Our results confirmed the hypothesis that reported sick leave due to LBP in the previous year was associated with self-reported very physically demanding work and high FAB and to a lesser degree with "objective" intensity of specific types of physical workloads. The poor correlation between JEM variables and self-reported physical demand supports this conclusion.

Limitations

The study is based on cross-sectional baseline data from a randomized controlled trial with the aim of retaining participants with physically demanding work and LBP in their job. This limits our ability to investigate causality. The trial included only participants with self-reported physically demanding or very demanding work and concern about their ability to maintain their current job. The resulting FAB score and self-reported physical demands may consequently have been inflated and can result in a lack of contrast among the participants and therefore between the groups. An association was found, and the estimate is probably conservative. Furthermore, use of JEMs entails risk of misclassification of exposure,[23] as people with the same job title may have different exposure to physical workloads and using expert assessment of exposures at the occupational level may therefore miss potentially large individual differences and peak exposures. This can also lead to conservative estimates of associations. Another limitation is the dichotomizing of the JEM based physical workload exposures and of the FABQ-W. No gold standard exists regarding cut-off values for either. Several different methods have been proposed and used, and none have been validated.[8] We used FABQ-W score at 20 or less for low FAB as proposed by others[8,21] and medians for JEM based physical workload exposures. This may also increase the risk of misclassification and therefore underestimate differences between groups. Self-reported sick leave is sensitive to recall bias. However, a meta-analysis has found reasonable rank order convergence with record-based data[24], for which reason we trust in the outcome data. This study includes a selected group of participants with physically demanding work. We did not adjust for socioeconomic status due to risk for over-adjusting since workers with lower socioeconomic status tend to have more physically demanding work.[25] Sample size might explain the wide confidence intervals on all modifications by JEM, but since all odds-ratios are close to 1, it is hardly a question of lack of strength in the data. Neither was there a problem with data contrast in exposure variables of the JEM.

Self-reported workload exposures are often used as exposure variable, although it may have a validity problem, as individuals with musculoskeletal complaints tend to overestimate their exposures.[14] In this study, we have overcome this problem by using a job exposure matrix in combination with perceived self-reported physical demand.

Interpretation

The low correlation between self-reported physical demand and JEM variables and no modifying effect of JEM variables indicates that self-reported physical demand might be a more independent risk factor than expected. This may be an expression of the participants assessment of their own physical work capacity with LBP or another work-related factor that we have not investigated. Due to the exclusion of participants with low self-reported physical demand we were unable to explore this further.

The Lower Body JEM has recently been used on a large general working population and found an exposure-response relation between ton- lifting- and kneeling years and all-cause long term sick leave.[26] The contrast with our results may be due to different definitions of exposure (medians vs ton-/lifting-years), older but healthier population and long term versus relatively short-term sick leave.

Participants with different durations of LBP have different prognostic outcomes. It has been shown that FAB is associated with poor prognosis in LBP of any duration, but stronger with subacute LBP.[8,27] Our results confirm the association between high FAB and sick leave although many of our participants, in addition to a subacute period of LBP, also had a longer history of LBP.

Self-reported physical workloads and sick leave have been found to be associated.[11–13] Recently, 5076 workers in Denmark have been investigated and self-assessed life-long hard physical work and in particular lifting/carrying tasks were found to be associated with all-cause long-term sick

leave.[28] Similar results was found in shipyard workers, where a borderline significant association between sick leave due to LBP and self-reported physical work factors was found.[29] Our results are in line with these findings, although we used other exposure definitions. In contrast, a longitudinal study with 6 months follow-up among 407 industrial workers used high perceived physical workload as exposure variable, but found no association with sick leave due to LPB.[30] This result can however be explained by low number of workers reporting sick leave or having LBP.

In a large review regarding acute LBP and sick leave, Steenstra et al found strong evidence for heavy work, in various definitions, as a predictor for duration of sick leave.[31] A later review by the same author regarding patients with subacute and chronic LBP, a population more similar to ours, concluded insufficient to moderate evidence for an association with physical demands at work.[25]

Lifting, trunk flexion and rotation increased the risk of sick leave due to LBP in a longitudinal study with video-documented physical exposures.[32] In our study, we did not use objective measurements but instead a JEM, which may explain the difference between the results because of the risk of misclassification of exposure by using a JEM. This illustrates the importance of further large studies with objective measures of physical workload and prospective designs.

CONCLUSION

Our study suggests that self-reported high physical demand at work and high fear-avoidance are associated with reported sick leave due to LBP in the previous year in individuals with physically demanding jobs. We found no association between reported sick leave due to LBP in the previous year and high physical workloads, except for number of heavy lifts measured by JEM. Interestingly, the high physical workloads did not modify the associations with sick leave in participants who rate

their work as very demanding or with high fear-avoidance scores. The poor correlation between JEM variables and self-reported physical demand indicates, that occupational interventions to reduce sick leave due to LBP may have to focus more on those with high self-reported physical demands and high fear-avoidance, and less on individuals with the objectively highest physical workload.

Footnotes

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Contributorship statement: JAP, LK, BBH, LMB, EMF, AIK: Study concept and design. JAP, BBH, LMB, AIK: Data acquisition. JAP, BBH, EMF: Statistical analysis. JAP, LK, BBH, LMB, EMF, MB, PH, HB, AIK: Analysis and interpretation of data and critical revision and approval of the final manuscript. JAP: Drafting of the manuscript. All authors reviewed drafts and approved the final manuscript.

Data sharing statement: Research records and data collection are obtained according to the Danish Personal Data Act (DPA) guidelines and any extra data is available upon request under the terms of DPA and European GDPA. The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. Full dataset to replicate the main analysis is available from the corresponding author on reasonable request

Competing interests: there are no competing interests for any author.

Figure legend: Figure 1: Flow chart for the actual study in the GoBack trial.

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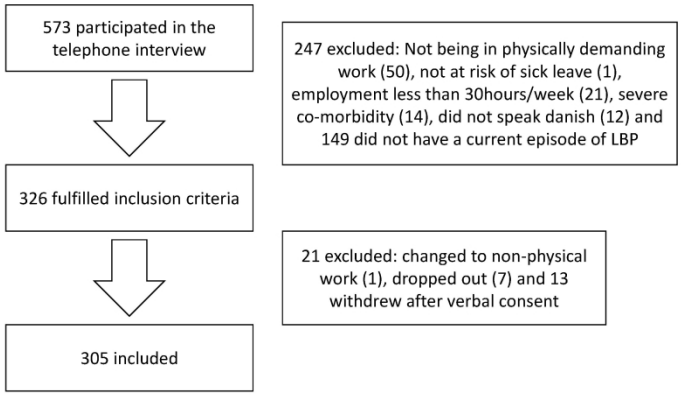

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	7-8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	Figure1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9

		(*b*) Report category boundaries when continuous variables were categorized	tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.