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RESEARCH PAPER

Psychosocial working conditions and the subjective prognosis of gainful employment among employees with asthma: a cross-sectional study

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ABSTRACT

Purpose: The present study set out to examine whether low job decision latitude (JDL, i.e., limited work autonomy) and low social support at work are related to a poor subjective prognosis of gainful employment (SPE) among working rehabilitants with asthma.

Methods: JDL and support were assessed by the Copenhagen Psychosocial Questionnaire. The SPE was measured by a validated three-item scale. Separate logistic regression analyses were conducted for all variables to calculate odds ratios (ORs) with 95% confidence intervals (CIs).

Results: Among the 221 participants (response rate = 29.3%), those reporting low JDL or low support had more than doubled odds of being unsure that they would be working until retirement age (OR = 2.28; 95% CI = 1.19–4.37; OR = 2.78; 95% CI = 1.43–5.40, respectively) and of considering their work ability permanently at risk due to ill-health (OR = 3.89; 95% CI = 2.03–7.46; OR = 2.05; 95% CI = 1.08–3.90, respectively) compared to those with good working conditions. The associations of JDL or support were weaker with one's consideration to apply for premature pension (OR = 1.54; 95% CI = 0.60–3.98; OR = 2.18; 95% CI = 0.83–5.77, respectively). Additional analyses identified job satisfaction as a possible explanatory factor for the observed relationships.

Conclusions: Adverse psychosocial working conditions are related to a poor SPE, and low job satisfaction may explain those relationships. Future prospective research is needed to confirm our findings.

➤ **IMPLICATIONS FOR REHABILITATION**

- Earlier research suggested that asthma increases the risk of disability retirement and thus causes high direct and indirect costs.
- Prior findings showed that adverse psychosocial working conditions are related to poorer asthma self-management and increased asthma morbidity among rehabilitants with asthma.
- Consistent with earlier work the present study found that job decision latitude and social support at work are associated with the subjective prognosis of gainful employment among working rehabilitants with asthma.
- If the reported findings are confirmed by prospective studies, interventions could be developed to improve the working conditions for rehabilitants with asthma and to thereby reduce their risk of disability retirement.

Introduction

In Europe, disability pensions accounted for 8.6% of the total pension expenses and for 11.8% of the overall number of pension recipients in 2015 [1]. Chronic illness increases the risk of disability retirement [2,3]. Disability retirement refers to a reduced earning capacity due to ill-health and may also include younger retirees, in contrast to early (non-disability) retirement, which refers to older people entering retirement a few years earlier than the statutory retirement age (legislation may differ across countries) [4,5].

Disability retirement is also related to asthma – a condition that causes high direct and indirect costs, for instance due to disability-related expenses [6–8]. Asthma-onset can occur at any age, but is most frequently diagnosed in childhood [9]. This implies that affected individuals usually live with their condition throughout most of their life, including work life. Research has suggested that workers with asthma may to some extent attribute adverse working outcomes to their condition: Examples include the perceived failure to pursue the desired career, not getting promoted, changing jobs or work duties, reducing work hours, or job loss

[6,10]. In particular, employees with severe and poorly controlled asthma report high work disability (for instance measured as self-rated working capacity expressed in percent [11], missing complete or partial workdays or exit from the workforce [12]) and unemployment [11–15]. A European survey among patients with asthma who were currently treated showed that only 20% had adequately controlled asthma [16]. It is therefore conceivable that there are further influencing factors – apart from effective medical treatment – on asthma control, e.g., compliance to treatment. For instance, half of the Europeans who received control medication for their asthma and did not take it as prescribed stated that they saw no need to use their control medication [16]. Compliance to treatment might be hampered by contextual factors, e.g., the work environment. Another influential factor on asthma control is asthma self-management, i.e., symptom prevention (such as trigger avoidance), acute symptom management (such as breathing techniques in case of wheezing), or communication with others (e.g., colleagues and line-managers) [17–19].

In addition to chronic illness, poor psychosocial working conditions can be associated with premature retirement. According to prior research, crucial factors seem to be elements of the well-established job demand-control model: Specifically job decision latitude (JDL; i.e., the decision authority over the work tasks and when and how to perform them) and social support by colleagues and line-managers influence the employees' coping with high job demands and the experience of mental strain [20,21]. Low social support at work and poor JDL were not only found to be related to self-management and asthma control [19], but also to disability retirement [4,22,23], intended early retirement [22,24–27], and a poorer employment prognosis [28].

There may also be a relationship between poor working conditions and disability retirement among workers with asthma, which is often related to reduced work ability [11–13]. Research has sought to identify early markers of premature retirement. One such marker is one's subjective prognosis of gainful employment (SPE) [29]. Nevertheless, to our knowledge, associations between working conditions and the SPE have not been examined yet specifically among employees with asthma. Only among employees with unspecified long-term conditions, a relation between support and the SPE was investigated [28]. The aim of this study was to explore if adverse psychosocial working conditions, i.e., low JDL and low levels of social support at work, are related to a poor SPE specifically among employees with asthma.

Methods

Study population

In Germany, inpatient rehabilitation aims to maintain or improve the health of patients with long-term conditions to ensure social participation in private and professional life. In the current study, senior physicians in three pulmonary rehabilitation clinics (i.e., Median Klinik Heiligendamm, Nordseeklinik Borkum, and Klinik Bad Reichenhall) screened the records of patients who were about to begin pulmonary rehabilitation because of their asthma. Patients with an established asthma diagnosis were selected, and those with comorbid chronic obstructive pulmonary disease (COPD) were excluded to strengthen the case definition [30]. Patients received questionnaires either by mail as soon as they were registered (Bad Reichenhall) or in personal contact during their first week of inpatient treatment (Heiligendamm and Borkum). A total of 221 eligible questionnaires was returned between October 2017 and May 2018 (response rate = 29.3%).

Patients' questionnaires were only used when all of the following criteria were met according to self-report:

1. a diagnosis of and current treatment for asthma, but not COPD;
2. employment of at least 20 working hours per week in the last six months;
3. having worked with the diagnosis for at least six months.

Criteria 2 and 3 were applied to ensure that the participants had worked for a reasonable period of time with asthma.

Measures

Psychosocial working conditions

Specific subscales from the German version of the Copenhagen Psychosocial Questionnaire [31,32] were used to assess JDL and social support. These two variables were – according to prior work [18,19] – relevant working conditions to employees with asthma in terms of disease self-management at work. To measure JDL, a combination of the scales "influence at work" (3 items, e.g., "Do you have any influence on what you do at work?") and "degree of freedom at work" (2 items, e.g., "Can you decide when to take a break?") was chosen. The associated items represented the findings from our prior qualitative research most closely [18] (Cronbach's alpha: $\alpha = 0.78$). Furthermore, the scale "social support" (Cronbach's alpha: $\alpha = 0.90$) was used, which comprises four items assessing support by colleagues and line-managers (e.g., "How often do you get help and support from your colleagues?"). Responses were provided on a frequency-based five-tier answer format ranging from "never/hardly ever" to "always". The mean score for each variable ranges from 0 to 100, and higher values indicate higher levels of JDL or support, respectively. JDL and social support were dichotomized by their respective tertile (bottom tertile = low JDL ($\leq$30) or low support ($\leq$37.5), respectively; remainder = high JDL or high support, respectively). This approach is in line with previous research on psychosocial working conditions such as JDL [19,33–35].

An instrument called the "Determinants of work-related asthma self-management [DReAM]" scale assessed additional working conditions that were shown to be relevant to employees with asthma in prior research [18]. The authors constructed this questionnaire, which was used in previous research [19]. Originally, 36 items were devised to assess working conditions that were identified to facilitate or impair asthma self-management at work, e.g., the possibility of trigger avoidance or to take a break in case of acute symptoms. Cognitive interviews with employees with asthma ($n = 13$) and numeric ratings ($n = 22$) were used to assess the rehabilitants' opinion on the respective items. By excluding the subjectively less relevant ones, the item set was reduced to 14 items, which was used in this study. An exploratory factor analysis with orthogonal rotation (Varimax) led to a final set of seven items, which loaded on one single factor (factor loadings ranging from 0.54–0.82; Cronbach's alpha = 0.83). Details on the development of the DReAM-scale can be found in the Additional file 1 of reference [19]. The DReAM-scale comprises seven items (example: "In my everyday work, I can manage my asthma the way I need to because I can withdraw from others for my asthma management"), which were presented with four possible answers each (from "agree completely" [scored as 1] to "not at all" [scored as 4]). The resulting sum-score ranges from 7 to 28. Lower values indicate better working conditions. To harmonize the distribution across predictors, the sum-score was also

dichotomized at the top tertile of the score distribution (>21) to define adverse working conditions.

Subjective prognosis of gainful employment

The three items assessing the SPE increase in severity in terms of their implications in case of unfavorable responses (rep (Guttman scaling)=0.99): 1. "When you consider your current health and work ability: Do you believe that you will be working until retirement age?", 2. "Do you consider your work ability permanently threatened by your health status?", and 3. "Do you consider an application for premature pension (due to ill-health)?" [36,37]. The first item has a five-tier answer format (1="sure"; 2="rather yes"; 3="unsure"; 4="rather not"; 5="in no case") and was dichotomized at the median, as proposed by the developers [36]. Regarding item 1, agreement (answers 1 or 2) indicates a positive prognosis while uncertainty and disagreement (answers 3 to 5) reflect a poor prognosis. The other two items have two response options (no/yes) with "no" reflecting a positive prognosis and "yes" a poor prognosis. The constructed sum-score across the three binary individual items ranges from 0 to 3. This sum score was dichotomized into 1 to 3 (poor SPE according to at least one of three items) versus 0 (positive SPE).

Data analysis

To estimate odds ratios (ORs) and corresponding 95% confidence intervals (CIs), separate logistic regression analyses were conducted for all dependent and independent variables using IBM SPSS Statistics 25. With regard to working conditions (i.e., the independent variables), the following reference categories were defined: high JDL, high support, and good working conditions according to the DReAM-scale (i.e., a low score). The three individual items assessing the SPE and their dichotomized sum-score served as dependent variables. In a first step, the regression models were adjusted for age and sex only. Additional adjustment in a multivariable model included one's highest educational degree, body mass index (calculated from self-reported weight and height), and smoking status (never, current, former).

To examine possible relationships more thoroughly, in particular potential explanatory factors, several additional analyses were carried out: First, it was investigated to what extent the subjective work demands are able to explain any potentially observed associations. The item "How would you describe your working demands?" was presented with three response options: "mainly cognitive and social demands (e.g., service professions), "mainly physical demands (e.g., construction work)", and "a mixture of cognitive/social and physical demands" (e.g., health professions). It is conceivable that in particular physical demands – especially when the employee cannot control those demands – interfere with asthma self-management and asthma control because physical activity may induce asthma symptoms. Second, employment in a potential asthma high-risk profession was examined as an explanatory factor because the implementation of asthma-self-management and achievement of asthma control might be particularly challenging in those professions. The participants were asked to state their profession, and this information was categorized by two authors (KH and AL) as "low-risk" or "high-risk" for asthma according to an inventory of 18 high-risk professions for asthma, identified by Ghosh et al. [38]. Third, the potential role of comorbidity was examined. Participants were asked to report if they had ever received any other diagnoses by a physician (one respective item for a total of 20 conditions; answers: no/yes). Illnesses that comprise allergic responses or inflammation of the

respiratory tract were excluded as those conditions may overlap with asthma. Further, rarely reported diagnoses were excluded (<15% or n < 33, e.g., arthritis/rheumatism, irritable bowel syndrome or type 2 diabetes). Applying those criteria, hypertension (38.0% prevalence) and migraine (18.1%) remained as the only comorbidities. The multivariable models were adjusted for those illnesses. Fourth, asthma control was added to the multivariable model, measured with the Asthma Control Test (ACT) and categorized into uncontrolled (<20 points) versus controlled (≥20 points) [39,40]. The rationale for this analysis builds on prior evidence showing i) that adverse psychosocial working conditions may relate to poorer asthma control [19,41] and ii) that employees with uncontrolled asthma report higher work disability and unemployment [11–15]. In the fifth analysis, job satisfaction was included into the multivariable-adjusted models because this factor has been identified as a predictor of early retirement in previous studies [27,42–44]. Job satisfaction was assessed by a single self-devised item ("How satisfied are you with your current job in general?"). Participants were asked to answer by marking one of the numbers from 0 ("not at all satisfied") to 10 ("completely satisfied") with a cross, which was transformed into a continuous score from 0 to 100.

Results

The characteristics of the sample (n = 221) are shown in Table 1. The participants' mean age was 50.6 years (standard deviation = 8.7 years), and 53.8% were women. Around two-thirds of the sample had at least a secondary school degree or were overweight/obese. With around 6%, the percentage of current smokers was quite low, but comparable to other studies among patients with asthma [e.g., 45]. Asthma was uncontrolled according to the ACT among almost two-thirds of the study sample. Concerning JDL and support, intermediate values were observed among the participants (i.e., mean = 45.6 [out of 100] for JDL and mean = 53.7 [out of 100] for support, respectively). In terms of the SPE, 57.5% thought that they would not be working until retirement age, 33.0% reported their work ability was permanently threatened by their health status, and 11.8% considered an application for disability pension. According to the sum-score, about one-third of the participants had a fully positive prognosis, i.e., believing to maintain work ability until retirement age, not reporting their work ability as impaired by ill-health, and not considering disability pension.

Table 2 depicts the estimates of the relationships between psychosocial working conditions and the SPE items. According to the multivariable models, employees with asthma who experienced adverse psychosocial working conditions had more than doubled odds of being unsure or not believing that they would be working until retirement age (OR for JDL = 2.28; 95% CI = 1.19–4.37; OR for support = 2.78; 95% CI = 1.43–5.40; OR for DReAM = 3.20; 95% CI = 1.60–6.39) compared to workers with good psychosocial working conditions. Further, individuals who reported adverse working conditions (versus those who did not) had doubled to more than five-fold increased odds of considering their work ability to be permanently threatened by their health status (OR for JDL = 3.89; 95% CI = 2.03–7.46; OR for support = 2.05; 95% CI = 1.08–3.90; OR for DReAM = 5.55; 95% CI = 2.85–10.82). By contrast, there was no clear evidence of a relevant relationship between JDL and the consideration to apply for disability pension (OR = 1.54; 95% CI = 0.60–3.98) although it must be mentioned that the confidence interval was quite wide. The association of this outcome with support was somewhat stronger, but again

Table 1. Sample characteristics ($n = 221$).

Characteristic	
Age (years)	
Mean (SD)	50.6 (8.7)
Missing values; n (%)	2 (0.9)
Sex	
Women; n (%)	119 (53.8)
Men; n (%)	102 (46.2)
Missing values; n (%)	–
Highest school degree	
Lower than secondary school degree; n (%)	82 (37.1)
Secondary school degree; n (%)	74 (33.5)
Higher than secondary school degree; n (%)	62 (28.1)
Missing values; n (%)	3 (1.4)
Body mass index (BMI)	
Underweight, normal (BMI < 25); n (%)	61 (27.6)
Overweight (25 ≤ BMI < 30); n (%)	81 (36.7)
Obese (BMI ≥ 30); n (%)	76 (34.4)
Missing values; n (%)	3 (1.4)
Smoker	
No, never; n (%)	110 (49.8)
No, not anymore; n (%)	96 (43.4)
Current; n (%)	13 (5.9)
Missing values; n (%)	2 (0.9)
Job Decision Latitude (JDL)[a]	
Mean (SD)	45.6 (22.8)
Missing values; n (%)	2 (0.9)
Social support[a]	
Mean (SD)	53.7 (25.7)
Missing values; n (%)	12 (5.4)
DReAM[b]	
Mean (SD)	18.5 (5.1)
Missing values; n (%)	1 (0.5)
Subjective work demands	
A mixture of cognitive/social and physical demands; n (%)	101 (45.7)
Mainly cognitive and social demands; n (%)	90 (40.7)
Mainly physical demands; n (%)	28 (12.7)
Missing values; n (%)	2 (0.9)
Professions	
"Low-risk" for asthma; n (%)	177 (80.1)
"High-risk" for asthma according to Ghosh et al. [38]; n (%)	40 (18.1)
Missing values; n (%)	4 (1.8)
Asthma control[c]	
Controlled; n (%)	76 (34.4)
Uncontrolled; n (%)	145 (65.6)
Missing values; n (%)	–
Job Satisfaction[d]	
Mean (SD)	62.8 (24.0)
Missing values; n (%)	1 (0.5)
Work until retirement age	
"sure" and "rather yes"; n (%)	94 (42.5)
"unsure", "rather not", and "in no case"; n (%)	127 (57.5)
Work ability permanently at risk	
No; n (%)	142 (64.3)
Yes; n (%)	73 (33.0)
Missing values; n (%)	6 (2.7)
Consider applying for a pension	
No; n (%)	192 (86.9)
Yes; n (%)	26 (11.8)
Missing values; n (%)	3 (1.4)
Sum-score of subjective prognosis of gainful employment[e]	
Positive prognosis; n (%)	79 (35.7)
Poor prognosis; n (%)	133 (60.2)
Missing values; n (%)	9 (4.1)

[a]measured by the Copenhagen Psychosocial Questionnaire [31,32], range: 0 to 100, higher values indicating higher levels of JDL and support.
[b]determinants of work-related asthma self-management, measured by 7 self-constructed items, range: 7 to 28, lower values indicating better working conditions.
[c]measured by the Asthma Control Test [39,40].
[d]range: 0 to 100, higher values indicating higher levels of job satisfaction.
[e]range: 0 to 3, 0 = positive prognosis, 1 to 3 = poor prognosis (according to at least one of three items).

imprecisely estimated (OR = 2.18; 95% CI = 0.83–5.77). The corresponding relationship for the DReAM-scale was even more pronounced and statistically significant (OR = 2.64; 95% CI = 1.04–6.71). The sum-score of the three items assessing the SPE suggests that adverse psychosocial working conditions at least doubled the odds of a poor SPE (OR for JDL = 2.18; 95% CI = 1.09–4.35; OR for support = 3.19; 95% CI = 1.53–6.66; OR for DReAM = 4.72; 95% CI = 2.10–10.62).

Supplementary analyses showed that the multivariable ORs were only marginally attenuated when additionally adjusted (i.e., either separately or combined) for hypertension and migraine (data not shown). This also applied to asthma control (data not shown). When subjective working demands were added to the adjusted model, the estimates remained largely unaffected, apart from the relationship between the DReAM sum-score and SPE item 3, which was marginally attenuated and became statistically non-significant (OR = 2.54; 95% CI = 0.99–6.48). Similarly, two associations were rendered statistically non-significant when asthma high-risk professions were included in the adjusted model (JDL and SPE item 1: OR = 1.97; 95% CI = 1.00–3.92; JDL and SPE sum-score: OR = 1.96; 95% CI = 0.94–4.08). When job satisfaction was entered into the models, the ORs were considerably attenuated. The odds of reporting that one might not be working until retirement age according to JDL, support, and the DReAM-values decreased by around a quarter (OR for JDL = 1.68; 95% CI = 0.85–3.34; OR for support = 2.09; 95% CI = 1.03–4.21; OR for DReAM = 2.32; 95% CI = 1.12–4.82). The attenuation of the odds of considering their work ability to be permanently at risk in case of adverse working conditions was even stronger, that is, as much as 35.6% in case of low social support at work (OR for JDL = 2.85; 95% CI = 1.42–5.74; OR for support = 1.32; 95% CI = 0.65–2.69; OR for DReAM = 4.03; 95% CI = 1.98–8.22). Likewise, all associations with the consideration to apply for disability pension were attenuated. This held also true for the initially significant association with the DReAM-scale, which was reduced to a non-significant level (OR for JDL = 1.06; 95% CI = 0.37–3.02; OR for support = 1.48; 95% CI = 0.50–4.41; OR for DReAM = 1.94; 95% CI = 0.70–5.41). The odds of reporting a poor SPE in sum in case of adverse working conditions were attenuated by around 30% when adjusted for job satisfaction (OR for JDL = 1.51; 95% CI = 0.72–3.17; OR for support = 2.26; 95% CI = 1.04–4.92; OR for DReAM = 3.22; 95% CI = 1.37–7.53).

Discussion

In this study, low levels of JDL and social support are shown to be associated with a poor SPE among employees with asthma. This relationship is strongest for the SPE in terms of one's expectation to be unable to work until retirement age and in terms of one's perception that one's work ability is permanently threatened by the health status. The associations of JDL and social support with the consideration to apply for disability pension were not statistically significant, which could be due to the small sample size and the limited number of individuals agreeing to that item ($n = 26$). Rather high job satisfaction (mean = 62.8 points out of 100 possible points) might have caused this small number as job satisfaction is a predictor for early retirement [27,42–44].

The relationship between support at work and the SPE has been found in one prior study [28]. A poor SPE and intended early or disability retirement are not the same, because only one

Table 2. Odds ratios and 95% confidence intervals for subjective prognosis of gainful employment according to job decision latitude and support.

	Work until retirement age				Work ability permanently at risk				Consider applying for a pension				Sum-score (0 vs. rest)			
	Adjusted for age and sex		Multivariable[a]		Adjusted for age and sex		Multivariable[a]		Adjusted for age and sex		Multivariable[a]		Adjusted for age and sex		Multivariable[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
JDL																
High	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Low	2.32	1.24, 4.36	2.28	1.19, 4.37	3.76	2.00, 7.08	3.89	2.03, 7.46	1.82	.73, 4.58	1.54	0.60, 3.98	2.19	1.12, 4.30	2.18	1.09, 4.35
Support																
High	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Low	2.66	1.41, 5.01	2.78	1.43, 5.40	2.17	1.16, 4.05	2.05	1.08, 3.90	2.58	1.01, 6.60	2.18	0.83, 5.77	3.22	1.57, 6.57	3.19	1.53, 6.66
DReAM																
Good	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Adverse	2.72	1.43, 5.19	3.20	1.60, 6.39	5.63	2.94, 10.77	5.55	2.85, 10.82	2.55	1.05, 6.15	2.64	1.04, 6.71	4.69	2.14, 10.31	4.72	2.10, 10.62

OR: odds ratio; CIL: confidence interval; JDL: job decision latitude; support: social support by colleagues and line-managers; DReAM: determinants of work-related asthma self-management.
[a] adjusted for age, sex, highest educational degree, body mass index, and smoker status.

SPE-item refers to disability retirement. Therefore, our results add to previous research, which found that JDL is related to disability pensions in the general population and among participants with long-term conditions [4,22,23] and to early retirement intentions [24–26]. In this study, JDL and support were both considered and shown to be related to the SPE, which measures more than mere retirement intentions, e.g., by assessing work ability as well.

But there are also contradictory findings: For instance, de Wind et al. [5] found that Dutch employees with *higher* levels of support were more likely to leave the workforce early. One may speculate that support at work also includes a supportive attitude concerning early retirement intentions, especially among older employees. It must be noted though that that Dutch study focused on early retirement and was conducted among older workers (i.e., aged 58 to 62 years), who are thus closer to formal retirement age. The determinants of early retirement might differ from those of disability retirement. For instance, disability retirement intentions might most likely be associated with health factors. Besides health, early retirement intentions among older employees seem to depend on job characteristics, skills and knowledge, social factors, and financial factors, as de Wind et al. [5] summarized. Further, retirement policies determine the financial aspects of early retirement, among others, and differ much across countries. Therefore, one must be cautious when making cross-national comparisons [45]. When putting the results into relation to other studies, it must also be noted that the SPE is too rough an instrument to assess differences between early retirement and disability retirement intentions.

It seems unlikely that the nature of subjective working demands, employment in an asthma high-risk profession, comorbid conditions, or asthma control serve as explanatory factors for our findings. Although single associations were influenced by subjective working demands and high-risk professions, the magnitude of the ORs was only marginally attenuated, and no systematic change could be found. Further, one may conclude that the results do not seem to be confounded by the presence of other diseases than asthma. The five ACT items assess how often one's asthma has impaired one's performance at home, at work, or at school, how often the patient has suffered from shortness of breath, how often they woke up early or at night due to asthma symptoms, how often they used their emergency inhaler, and how well-controlled they considered their asthma. All those items refer to the four weeks prior to completion of the ACT. This time period may be too short to explain links between working conditions and the SPE. Further, asthma control might vary across time, especially among our participants, who applied for or already began inpatient rehabilitation treatment. For instance, the associated change of treatment regime or better self-management skills could likely improve asthma control. In contrast, the perception of working conditions related to a given job is possibly more stable and may affect employees and their behavior over several years. The SPE refers to a rather long period of time: In Germany, the statutory retirement age equals 67 years. The study sample's mean age was around 50 years, implying that the SPE refers to a time span of over 15 years in average among the sample. Nevertheless, the observation that asthma control does not explain the observed associations is rather surprising in light of prior research which reported associations of uncontrolled asthma with higher work disability and unemployment although one might question the comparability of those studies with our work [11–15]. For instance, none of the studies used the SPE as an outcome. Future research is encouraged to explore the role of

asthma control in studies including different outcome measures related to disability retirement.

The associations of adverse working conditions with a poor SPE seem to be partly explained by job satisfaction. This adds to findings from previous studies, which identified job satisfaction as a predictor of early retirement [27,42–44]. Further, job satisfaction was shown to be associated with support [46,47] and JDL [48,49]. It is conceivable that adverse working conditions reduce one's job satisfaction and thereby one's intrinsic motivation at work because the latter two constructs are closely interrelated [50,51]. This could result in a poorer SPE as low job satisfaction also predicts early retirement [27,42–44]. Oakman and Wells [44] found that job satisfaction is, firstly, higher among older workers and, secondly, that job satisfaction becomes a more important predictor for the intention to retire early with increasing age of workers. These observations may explain why job satisfaction partially accounts for the observed link between working conditions and the SPE in this sample: The mean age was around 50 years, which can be considered as advanced given individuals' potential employment period. Additionally and as mentioned above, the participants in this study reported a rather high level of job satisfaction. Consequently, they may also have considered their job satisfaction as a crucial factor when considering disability retirement. In the study by de Wind et al. [5], motivation was indeed shown to be related to social support at work, but as mentioned above, not to early (non-disability) retirement. It needs to be further investigated whether or to what extent motivational aspects are more influential on the found relationships between working conditions and the SPE than the nature of one's working demands, employment in an asthma high-risk profession, or illness-specific variables (e.g., experienced symptoms and illness-related impairments).

Limitations

First, since this work focuses on employees with a chronic disease and their SPE, it cannot be ruled out that the results are affected by the healthy worker effect (HWE), which puts forward that it is easier for healthy individuals to stay in the workforce than for workers with ill-health [52]. Our sample may predominantly consist of individuals who do not suffer from very severe asthma because those patients might already have left the workforce. However, by recruiting the study participants through rehabilitation clinics, the included individuals were at risk of dropping out of the workforce without having left it yet. Indeed, the proportion of participants with uncontrolled asthma according to the ACT seemed to be rather high in this sample (65.6%) compared to other studies, which did not specifically focus on rehabilitants (ranging from 44.7% to 59.31%) [16,41,53]. Demoly et al. [54] found very similar numbers for Germany (65.3%). Maybe perceived social desirability made the participants report low asthma control levels: It is conceivable that the rehabilitants wanted to "prove" their illness status while in inpatient treatment. Still, in this sample, the proportion of individuals reporting a positive SPE (n = 79; 35.7%, see Table 1) was higher compared to the sample of another study by Mittag et al. [29], which comprised employees with low back pain or functional syndromes (n = 33; 6.9%). This could be due to the fact that Mittag et al. applied inclusion criteria that referred to the severity of the conditions and thus chose severe cases only [29]. In this study, by contrast, the mere diagnosis of asthma sufficed - besides the fact that the individuals were currently in medical rehabilitation treatment. Possibly, the associations observed in this study would have been more pronounced

if the sample had been restricted to employees with severe asthma. However, re-run analyses exclusively among employees with uncontrolled asthma (n = 145) showed no consistent pattern of change. Second, the response rate (29.3%) was rather low, but comparable to other studies among individuals with chronic respiratory conditions [55]. Apart from age and sex, the cooperating clinics were unable to provide any further information on their whole patient population, i.e., all the rehabilitants with asthma in the clinics in the time period of recruitment. Therefore, detailed non-responder analyses were not feasible. The gender distribution in the study sample (53.8% women) was however comparable to that in the entire population (55.6% women). Concerning age, the study sample was somewhat younger (50.6 years) than the entire sample (51.3–55.4 years in the three clinics). Third, the analyses built on cross-sectional and self-reported data. Longitudinal and objective measurements, e.g., the actual event of disability retirement, would have provided more valid information and permitted statements concerning potential causality between variables with greater confidence. Fourth, although the ORs reached meaningful magnitudes across all analyses, some associations did not reach conventional thresholds of statistical significance. This could be due to limited statistical power as reflected in rather wide CIs. Therefore, one may assume that some associations would have reached statistical significance in a larger sample.

Conclusions

This study found that adverse psychosocial working conditions are associated with a poor SPE. Those associations were explained by job satisfaction to some extent. In future research, the interrelationships between JDL, support, the SPE, and job satisfaction should be further investigated, e.g., in longitudinal studies to gain better insights into potential cause-effect relations. Further, it seems to be worthwhile to extend the samples to participants with other – or without any – chronic conditions to gain further knowledge of the general interaction mechanisms between working conditions, the SPE, and job satisfaction. In addition, given that prospective data supports our observations, it seems advisable to develop interventions for rehabilitants with asthma, which aim at improving their psychosocial working conditions with emphasis on their job satisfaction. For example, patient education programs at rehabilitation clinics could be expanded to include specific modules to prepare individuals for their return-to-work. These modules may be supplemented by interventions or educational programs at workplaces. Improved cooperation and communication between rehabilitation clinics and occupational health services, supervisors or other occupational stakeholders at work also seem promising in this respect. For instance, it is conceivable that the treating physician contacts the company's occupational physician – given that the patient grants permission – to discuss the opportunities to adjust the patient's workplace. Another challenge to address is to establish an organizational culture of transparent communication and trust. Line-managers could benefit from educational opportunities to improve their abilities to lead a team with chronically ill members. To openly negotiate among the colleagues and between employees and line-manager and/or the employer could have great potential to improve the working conditions for employees with (but also for those without) chronic conditions. Such interventions should focus on measures to increase JDL, support at work, and job satisfaction to reduce the risk of disability retirement in the long run.

Acknowledgements

Ethical statement

Our study follows the principles of the Declaration of Helsinki and received ethical approval by the Institutional Review Board of the Medical Faculty of the Heinrich-Heine University of Düsseldorf (no. 5764 R). Informed consent was obtained from all patients for being included in the study.

Disclosure statement

Funding

Data availability

Raw data were generated at the Institute of Occupational, Social, and Environmental Medicine at the University of Düsseldorf. Derived data supporting the findings of this study are available from the corresponding author AL on request.

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