


ORIGINAL ARTICLE

Contextual factors in persistent severe back pain: A longitudinal analysis among German employees

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Abstract

Background: Chronic back pain in employees compromises participation in social and daily activities, as well as work.

Objectives: To examine the severity of back pain after 2 years and identify factors predicting stagnation at this level of pain.

Methods: Data were derived from a prospective cohort study with randomized sampling of insured persons in the German Pension Insurance using a questionnaire at baseline and follow-up after 2 years. The sample consisted of middle-aged employees (45–59 years) with strong limitations due to back pain (Chronic Pain Grade III or IV), who had not applied for disability pension and did not use medical rehabilitation in the previous 4 years before baseline. Stepwise multivariable logistic regression models with backwards selection were used to identify relevant contextual factors in the stagnation of severe back pain.

Results: Of 1208 persons with severe back pain at baseline, 48% had stagnated at that pain level after 2 years. Predictors of persistent severe back pain were older age, poorer general health, more additional disabling conditions, more depressive symptoms, caregiving burden, less pain-related self-efficacy and more fear avoidance beliefs.

Conclusions: In a high-risk subgroup with several co-existing conditions, this analysis highlights (mental) health, social and personal (contextual) factors associated with long-term unfavourable back pain progression.

Significance: Back pain is a condition that often has a chronic or recurrent course, threatening participation in many areas of life. In this study it was found that the unfavourable condition of severe back pain can remain stable for long periods of time in a significant proportion of sufferers. Contextual factors (self-efficacy, fear-avoidance beliefs, caregiving burden) as well as additional health problems should be considered when identifying persons with stagnating pain courses.

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1 | INTRODUCTION

Back pain is a rising factor in the number of years lived with disability (Chen et al., 2022). While some patients achieve a rapid reduction in pain within the first few weeks, there is often little change 3–6 months after the onset of acute back pain (Artus et al., 2014; Itz et al., 2013; Pengel et al., 2003). Between 17% and 26% of persons with back pain continue to experience high levels of pain (Dutmer et al., 2020; Hestbaek et al., 2003; Schuller et al., 2021).

Persons with back pain report that the pain interferes with everyday life, many needing assistance with household chores and reducing or giving up leisure time activities (Mattila et al., 2011). Furthermore, patients describe difficulties in social relationships and concerns regarding illness stigma, threatening their quality of life (Froud et al., 2014). Living with persistent pain can be experienced as isolating, unfair, feeling a lack of control and helplessness (van Griensven, 2016). Against the background of these manifold consequences of ongoing pain, this article will pay special attention to the stagnation of severe back pain. In this analysis, we want to identify factors that favour poor long-term outcomes, so that persons with unfavourable courses can be identified earlier and receive better care.

Considering threatened participation in working life, middle-aged employees are a critical group for the German health system, as they are the primary users of rehabilitation services (Deutsche Rentenversicherung Bund, 2020) and disability pensions as an early exit from employment could endanger their financial security. In this age group, health-related limitations in daily life activities rise rapidly (Heidemann et al., 2021), and musculoskeletal diseases are highly common (Chen et al., 2022; Palmer & Goodson, 2015).

Previous studies have identified the following influencing factors for back pain progression: pain intensity at onset and previous back pain episodes, lifestyle factors (e.g. smoking, physical inactivity) as well as other chronic conditions (e.g. diabetes, depression), sleep, comorbidity, working conditions, unemployment and healthcare utilization (Alsaadi et al., 2014; Dunn et al., 2011; Hartvigsen et al., 2018; Kongsted et al., 2016; Verkerk et al., 2015). Psychological factors, such as pain-related cognitions and psychological distress, also seem particularly relevant to the management and progression of pain and associated disability (George & Beneciuk, 2015; Hartvigsen et al., 2018; Wideman & Sullivan, 2011).

However, publications with patient and physician perspectives (Froud et al., 2014; Glocker et al., 2013) suggest that social components and personal factors

play an underestimated role in the experience and management of back pain. Therefore, this analysis focuses on personal and environmental factors in addition to health variables as potential long-term determinants of persistent severe back pain. This paper extends current research by centring a risk group of persons already suffering from back pain and focussing on stagnation using a multidimensional measurement of back pain, a large population sample and longitudinal analysis with a 2-year follow-up. To enable early identification of unfavourable back pain courses, this study asks: What are the characteristics of patients who do not get better in the long term?

2 | METHODS

2.1 | Study design

Data for this analysis were derived from a prospective cohort study (German Clinical Trials Register: DRKS00011554) conducted to analyse barriers to accessing rehabilitation (Zimmer et al., 2022) and effectiveness of medical rehabilitation services for persons with back pain (Fauser, Schmitt, et al., 2022). The study included postal questionnaires at two measurement points (baseline: 2017, follow-up: 2019) and linked administrative data of the German Pension Insurance. The methods of the initial cohort study are described in the study protocol published previously (Bethge et al., 2017). The ethics committees of the University of Lübeck (15–144) and Martin-Luther University Halle-Wittenberg (2015–49) approved the study. The study is registered in the German Clinical Trials Register (DRKS00011554).

2.2 | Sample

For the initial cohort study, a random sample of insured persons was drawn from the registries of two pension agencies in Germany (German Pension Insurance North and German Pension Insurance Central Germany). The inclusion criteria were employment and middle age (45–59 years). Exclusion criteria were a previous application for disability pension benefits and the utilization of medical rehabilitation services in the previous 4 years. Furthermore, persons with back pain were identified at baseline using the “Chronic Pain Grade” (CPG) measure (Korff et al., 1992). The follow-up was conducted only for persons who had self-reported some degree of back pain (CPG I to IV) in the preceding 3 months of the baseline survey.

The CPG is based on a brief questionnaire encompassing measures of pain intensity and pain disability. It classifies the severity of back pain in a hierarchical structure, from low-intensity (CPG I) to high-intensity pain (CPG II) with limited disability to moderately (CPG III) or highly disabling (CPG IV) pain regardless of intensity. The CPG was translated into German and then validated, with good psychometric properties (Klasen et al., 2004).

For the present analysis, we observed only persons who reported disabling back pain at baseline, by definition encompassed in a CPG of III or IV, and returned both questionnaires.

2.3 | Outcome

The outcome of interest was computed as a binary variable indicating persistent severe back pain at follow-up (CPG III/IV; reference: CPG I/II or pain free).

2.4 | Covariates

The focus for possible predictor variables at baseline were mainly contextual factors, that is, environmental and personal factors according to the International Classification of Functioning, Disability and Health (ICF) (Cieza et al., 2004; Glocker et al., 2013; Grotkamp et al., 2020). The ICF is a WHO framework for describing health by incorporating different dimensions of functioning and disability (body functions/structures, activities and participation as well as person-related and environmental contextual factors) (World Health Organization, 2001). Due to the biopsychosocial understanding of chronic back pain, we were guided by the ICF in selecting covariates. The respective variables were selected from the following areas: social environment, working conditions, health services, pain-related cognitions and sociodemographic variables. Health-related variables to control for the influence of other conditions were also included. The respective covariates are shown and explained in Table 1.

2.5 | Other variables

Additionally, we used data from the follow-up questionnaire on employment status (currently employed, yes/no), disability pension and the subjective prognosis of employability (SPE; 0–1 = “positive”/2–3 = “negative”; Mittag & Raspe, 2003) to describe outcomes of our sample. The self-reported number of sick leave days in the last year was also included in the sample characteristics.

2.6 | Statistical analysis

Persons in the sample were analysed descriptively regarding their back pain development after 2 years. In addition, we compared their participation in working life at follow-up (employment status, disability pension and prognosis of employability), grouped for the outcome (Chi²-test).

In order to identify potential predictors of persistent severe back pain, we used backwards selection of the covariates in multivariate logistic regression models. This means that all covariates per area, as illustrated in Table 1, are entered into the respective model as variables under consideration and through stepwise elimination, only the variables with explanatory value for the outcome remain.

We calculated stepwise models (each with backwards selection of variables) to:

1. Identify all relevant predictors of the outcome in the thematic areas (health, social environment, working conditions, health services, pain-related cognitions and sociodemographic variables),
2. Calculate a joint model including all the resulting variables from the backwards selection models in step 1.
3. The variables resulting from step 2 were used as the final model. As missing cases are dropped in the full case analysis, the number of cases is reduced in models with many predictors. Therefore, the final model was re-modelled with only the remaining final variables to increase the sample size.

The model fit is reported as Nagelkerke's pseudo- R^2 . Goodness-of-fit was assessed using the Hosmer-Lemeshow test. Regression models were performed for completely available data (complete case analysis).

The necessary assumptions for logistic regression were checked beforehand (Box-Tidwell test for linearity assumption, Spearman's correlations and VIF for exclusion of multicollinearity). The robustness of the final model was checked by recalculating the joint model (step 2) using forward selection and comparing the similarity of the results.

3 | RESULTS

3.1 | Recruitment and sample characteristics

Of the respondents of the study ($N=10,365$; of 45,000 contacted), the initial sample consisted of 6940 persons with varying degrees of back pain in the last 3 months.

TABLE 1 Overview of covariates.

Variable	Variable generation/source (clinimetric properties)	Variable values
Health (body functions)		
General health	Copenhagen Psychosocial Questionnaire/COPSOQ (Nuebling and Hasselhorn, 2009)	0–10
Number of disabling health problems	Limitation scale of the Self-Administered Comorbidity Questionnaire/SCQ-D (Streibelt et al., 2012)	0–15
Depressive symptoms	Patient Health Questionnaire depression scale/PHQ-8 (Kroenke et al., 2009)	0–24
Social environment (environmental factors)		
Relationship	“Are you in a committed relationship?”	0/1
Social support from colleagues	COPSOQ (Nuebling and Hasselhorn, 2009)	0–100
Caregiver for a relative	“Do you provide care for relatives who are chronically ill, disabled or in need of care?”	0/1
Household work strain	“How strained do you feel by household work?”	0–10
Care work – caregiving burden strain	“How strained do you feel by care work?”	0–10
Working conditions (environmental factors)		
Physical strain	Questionnaire on the subjective assessment of stress at the workplace/FEBA (Slesina, 1987)	0–15
Psychological demands	COPSOQ (Nuebling and Hasselhorn, 2009)	0–100
Job insecurity	COPSOQ (Nuebling and Hasselhorn, 2009)	0–100
Bullying	COPSOQ (Nuebling and Hasselhorn, 2009)	0–100
Health services (environmental factors)		
Hospital stay	Within last 12 months (excluding childbirth)	0/1
Ambulatory treatments	Within last 12 months; categorized	0: none 1: 1–12 2: >12
Pain-reducing medication	Within last 3 months	0/1
Mood enhancers	Within last 3 months	0/1
Other medication	Within last 3 months	0/1
Pain-related cognitions (person-related factors)		
Pain-related self-efficacy	Pain Self-Efficacy-Questionnaire/PSEQ (Nicholas, 2007)	10–60
Fear-avoidance beliefs: work	Fear-Avoidance Beliefs Questionnaire/FABQ (Pfungsten et al., 2000)	0–18
Fear-avoidance beliefs: physical activity	FABQ (Pfungsten et al., 2000)	0–18
Socio-demographics (person-related factors)		
Age	Calculated at time of baseline, administrative data	45–59
Sex	Administrative data	0: male 1: female
Level of education	Categorization following Deck and Hofreuter-Gätgens (Deck and Hofreuter-Gätgens, 2015)	1: low 2: medium 3: high
Occupational status	Categorization following Deck and Hofreuter-Gätgens (Deck and Hofreuter-Gätgens, 2015)	1: blue-collar worker 2: white-collar worker 3: civil servant or self-employed
Net Household income	“What is the total net income of your household (income of all household members- including pensions, child and unemployment benefits- after deduction of taxes etc.)?” (Deck and Hofreuter-Gätgens, 2015)	1: <1500€ 2: 1500–3000€ 3: >3000€

Filtering for disabling back pain at baseline resulted in a sample of 1547 persons. For this longitudinal analysis, we included 1215 persons who completed the follow-up questionnaire after 2 years with complete information on their pain level.

Persons in the analysis sample were on average around 53 years (SD = 4.1) old and 60% were women. On average, persons in this group reported two additional disabling conditions. Further sample characteristics are summarized in Table 2.

3.2 | Development of back pain and participation

All persons in this sample reported disabling back pain with a moderate (CPG III, 67%) or high (CPG IV, 33%) degree of limitations at baseline. After 2 years (follow-up), the sample could be dichotomized into those with an improved pain grade (<CPG III; 52%; $n = 629$) and the other half who continued to experience persistent or

worse back pain (\geq CPG III; 48%; $n = 586$). Figure 1 shows the allocation of the sample to the pain grades at both time points.

At follow-up, 8% of the stagnating group and 4% of the reference group were no longer employed ($p = 0.006$). Regarding a permanent withdrawal from the workforce, 44 (8%) of the persons with persistent severe back pain had applied for a disability pension, compared to 11 (2%) in the reference group ($p < 0.001$). Considering the long-term prognosis of occupational participation, at baseline 60% of the stagnating group (vs. 40% reference group) reported a negative prognosis of employability, which remained relatively stable at follow-up (64% stagnating group and 34% reference group).

3.3 | Predictors for persistent back pain

The result of the models (step 1) for predictive factors for stagnation is shown in Table 3 (resulting variables of backwards selection reported). The health-related variables

TABLE 2 Sample characteristics at baseline and follow-up.

	Baseline	Persistent back pain	Reduced back pain
	M (SD) or n (%)	M (SD) or n (%)	M (SD) or n (%)
General health (0–10)	5.4 (1.7)	4.9 (1.9)	6.2 (1.8)
Number of disabling health problems (0–15)	2.3 (1.9)	2.8 (2.0)	1.9 (1.7)
Depressive symptoms (PHQ-8, 0–24)	8.6 (5.0)	10.2 (5.3)	7.0 (4.7)
Days of sick leave (last 12 months)	40 (52)	78 (105)	48 (73)
Negative prognosis of employability (SPE)	579 (49.7%)	361 (64.2%)	208 (34.3%)
Currently employed	1213 (99.8%)	524 (91.8%)	592 (95.6%)
Age (45–59)	52.7 (4.1)	^a	^a
Sex: female	729 (60.0%)	^a	^a
Level of education		^a	^a
Low	269 (22.4%)		
Medium	864 (71.9%)		
High	69 (5.7%)		
Net household income		^a	^a
<1500€	193 (16.3%)		
1500–3000€	732 (61.7%)		
>3000€	261 (21.5%)		
Occupational position		^a	^a
Blue-collar worker	612 (50.3%)		
White-collar worker	571 (47.9%)		
Civil servants/self-employed	10 (0.8%)		

Abbreviations: M, Mean; SD, Standard deviation.

^aOnly assessed at baseline. $N = 1215$.

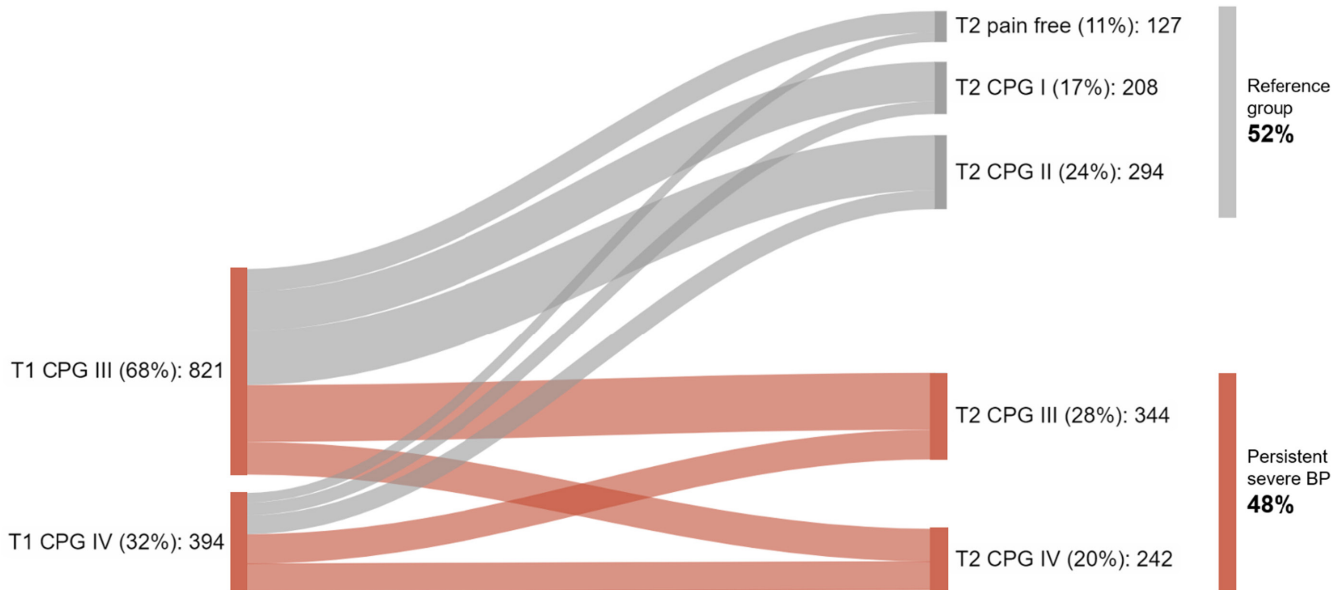


FIGURE 1 Chronic pain grade (CPG) at baseline (T1) and follow-up (T2); persistent severe back pain highlighted.

	OR	95% CI	p-value
Health			
General health (0–10)	0.866	0.805–0.932	<0.001
Number of disabling health problems (0–15)	1.145	1.067–1.229	<0.001
Depressive symptoms (0–24)	1.049	1.020–1.077	<0.001
Pseudo- $R^2 = 0.088$ [$n = 1141$]			
Social environment			
Social support from colleagues (0–100)	0.991	0.985–0.997	0.053
Caregiving burden (0–10)	1.051	1.012–1.091	0.009
Pseudo- $R^2 = 0.013$ [$n = 1132$]			
Working conditions			
Psychological demands (0–100)	1.013	1.006–1.019	<0.001
Pseudo- $R^2 = 0.017$ [$n = 1105$]			
Health services			
Painkilling drugs (last 3 months)	1.434	0.990–2.076	0.057
Medication for other conditions (last 3 months)	1.584	1.205–2.083	<0.001
Pseudo- $R^2 = 0.022$ [$n = 980$]			
Pain-related cognitions			
Pain-related self-efficacy (10–60)	0.965	0.953–0.976	<0.001
Fear-avoidance beliefs regarding work (0–18)	1.047	1.017–1.078	0.002
Pseudo- $R^2 = 0.066$ [$n = 1142$]			
Sociodemographic variables			
Age	1.052	1.022–1.082	<0.001
Pseudo- $R^2 = 0.014$ [$n = 1162$]			

TABLE 3 Predictive factors for persistent severe pain (backwards selection).

Abbreviations: CI, Confidence Interval; OR, Odds Ratio; Pseudo- R^2 , Nagelkerke's pseudo- R^2 .

had the highest model fit with a pseudo- R^2 of 0.088, followed by the model block regarding the pain-related cognitions (pseudo- $R^2 = 0.066$).

Factors predicting persistent severe back pain after 2 years were a higher number of disabling health problems and more depressive symptoms, a higher caregiving

TABLE 4 Final model of predictive factors for persistent severe back pain.

	OR	95% CI	p-value
General health (0–10)	0.901	0.833–0.975	0.010
Number of disabling health problems (0–15)	1.115	1.036–1.201	0.004
Depressive symptoms (0–24)	1.030	1.001–1.089	0.046
Caregiving burden (0–10)	1.045	1.003–1.089	0.035
Pain-related self-efficacy (10–60)	0.978	0.964–0.991	0.001
Fear avoidance beliefs regarding work (0–18)	1.038	1.006–1.071	0.018
Age	1.041	1.008–1.074	0.013
Pseudo- $R^2 = 0.122$ [$n = 1074$]			

Abbreviations: CI, Confidence Interval; OR, Odds Ratio; Pseudo- R^2 , Nagelkerke's pseudo- R^2 .

burden, higher psychological demands at work, taking pain-reducing medication as well as medication for other conditions in the last 3 months before baseline, more fear avoidance beliefs regarding work as well as a higher age. Better general health, social support from colleagues and more pain-related self-efficacy were associated with decreased risk of stagnating at the severe pain level.

The final model (Table 4), which included the remaining variables after backwards selection of the variables identified in the first step, had a Nagelkerke's pseudo- R^2 of 0.122. Goodness of fit was assessed using the Hosmer-Lemeshow test, indicating a good model fit, ($\chi^2(8) = 12.439$, $p = 0.133$). In this final model, better general health and higher pain-related self-efficacy at baseline decreased the risk of stagnation after 2 years. Additional disabling health problems, higher levels of depressive symptoms and fear avoidance beliefs, more caregiving burden and higher age increased the odds of stagnation.

4 | DISCUSSION

Focusing on the 2-year follow-up of a risk group of persons with disabling back pain, nearly half (48%) reported persistent severe back pain. Factors at baseline that predicted this long-term pain stagnation were general health, disabling health problems, depressive symptoms, caregiving burden, pain-related cognitions (specifically self-efficacy and fear avoidance beliefs) and age. The resulting model is significant and can contribute to explaining part of the stagnation process but the results also underline the complexity of the impairment situation due to the many significant factors that were present. Against the background of the long prognosis period and the pre-selected sample, the results give indications of unfavourable constellations in persistent back pain.

The prediction models showed the long-term effect of one's subjective assessment of general health as well as other health conditions on back pain development.

The frequency and significance of comorbidity in this sample with severe back pain is evident by on average two to three health problems that limited the respondents in their daily activities. Consequently, the at-risk group identified and followed up in this analysis is characterized by multiple possibly interacting health burdens, which makes treatment and disease management challenging.

The results concerning depressive symptoms are in line with previous studies that have shown a link between mental health and back pain (Stubbs et al., 2016), with symptoms of depression being a prognostic factor for low back pain, possibly caused by similar biological pathways or lifestyle changes exhibited by persons with depression (Pinheiro et al., 2015).

The endurance of pain cognitions in the models underlines the importance of personal factors for disease perception and development, especially in pain disorders. A review showed self-efficacy and fear to mediate the process leading from pain to disability (Lee et al., 2015). These findings may be due to a higher acceptance of pain in persons with favourable cognitions and thus more participation in daily activities, as seen among workers with nonspecific musculoskeletal pain (Vries et al., 2012).

The inclusion of social environment factors in the statistical models revealed caregiving burden to be a risk factor for persistent severe back pain, probably rooted in mechanisms between stress and health (Thoits, 2010). Caring for a relative does not seem to be a risk factor per se, but rather the extent to which people feel burdened by it (Blom et al., 2017). The burden of care and domestic work is receiving increasing attention in health research and is discussed in terms of gender inequality (Ervin et al., 2022; Sperlich et al., 2013). It also represents a double burden with job demands, since the sample at baseline consists only of employees.

In this analysis, a relevant risk group of people with disabling back pain could be identified. On the one hand, the selection of middle-aged persons seems to be particularly

relevant for chronic back pain. Even when considering all other predictors, age remained as a relevant risk factor for stagnation (despite the already narrow age range in the sample). In addition, a large part of the stagnation group assessed their own employment prognosis negatively, which is a predictor for interrupted employment and disability pensions (Fauser, Zimmer, et al., 2022). Those in our sample with persistent back pain were more likely to be out of employment or to have applied for a disability pension than the reference group of people with decreasing back pain. In the stagnation group, this prognosis is also already worse at baseline and then relatively stable after 2 years. Reasons can only be speculated based on our data; both self-fulfilling prophecy and accurate self-assessment by respondents based on possibly longer standing problems and risk factors are possible explanations. In light of these findings, the importance of early identification of individuals with risk factors for poor trajectories is reaffirmed.

4.1 | Limitations

The following limitations need to be considered when interpreting the results: First, 21% of the baseline analysis sample was lost to follow-up. As we do not have information on the progression of back pain between the two questionnaires, we cannot determine whether people were lost to follow-up because of improvement or increased pain, or at random. Secondly, the sample consisted of employees – working and on sick leave – of a certain age group, limiting generalizability. People being permanently work disabled were not considered in our analysis. Thirdly, although sleep disorders have been shown to have a bidirectional relationship with (chronic) pain (Haack et al., 2020), it was not included in the original study and could therefore not be examined as a potential predictor. Finally, with regard to health services, the specifics of the German social security, pension and healthcare system might limit generalizability in this area; however, this will always be the case with single-country studies and these variables did not emerge as relevant predictors.

4.2 | Conclusion

This longitudinal analysis of middle-aged employees with disabling back pain demonstrates that a significant proportion remains experiencing persistent severe back pain after 2 years. This stagnation was predicted by (additional) health conditions as well as modifiable contextual factors like caregiving burden and unfavourable pain-related cognitions. These individuals are at increased risk of withdrawal from

the work force. When caring for persons with back pain, it can help to consider relevant factors and constellations, and to target these through involved health care professionals.

AUTHOR CONTRIBUTIONS

Prof. Bethge and Prof. Mau developed the study design. Mrs. Zimmer, Mr. Fauser and Mr. Golla collected and cleaned the data. Mrs. Zimmer conceived and performed the analyses and wrote the manuscript. All authors revised the article critically and approved the manuscript before submission.

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CONFLICT OF INTEREST STATEMENT

None declared.

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