

RESEARCH ARTICLE

Psychological distress, personality traits, coping strategies, and functional recovery after elective spinal surgery: A longitudinal study

Friederike Weidemann^{1,2*}, **Johanna Tendai Zishiri³**, **Nora M. Laskowski^{4,5}**, **Stefan Budde⁶**, **Astrid Müller⁵**, and **Dorothea Daentzer⁷**

¹Department of Trauma Surgery, Hannover Medical School, Hannover, Germany

²Department of Intensive Care Medicine, HELIOS Medical Center Schwerin, University Campus of MSH Medical School Hamburg, Schwerin, Germany

³Department of Internal Medicine III, Darmstadt Hospital, Darmstadt, Germany

⁴University Clinic for Psychosomatic Medicine and Psychotherapy, Medical Faculty, Campus East-Westphalia, Ruhr-University Bochum, Luebecke, Germany

⁵Department of Psychosomatic Medicine and Psychotherapy, Hannover Medical School, Hannover, Germany

⁶Department of Trauma and Orthopaedic Surgery, Evangelisches Klinikum Bethel University Hospital OWL, University of Bielefeld, Bielefeld, Germany

⁷Department of Orthopaedic Surgery, Hannover Medical School, DIAKOVERE Annastift, Hannover, Germany

*Corresponding author:

Friederike Weidemann
(Friederike.Weidemann@helios-gesundheit.de)

Citation: Weidemann F, Zishiri JT, Laskowski NM, Budde S, Müller A, Daentzer D. Psychological distress, personality traits, coping strategies, and functional recovery after elective spinal surgery: A longitudinal study. *Health Psychol Res.* 2026;14(3):0482. doi: 10.36922/HPR0482

Received: January 9, 2026

Revised: June 29, 2026

Accepted: July 1, 2026

Published online: July 22, 2026

Copyright: © 2026 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons AttributionNon-Commercial 4.0 International (CC BY-NC 4.0), which permits all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract

Background: Psychological factors are frequently associated with pain and disability after spine surgery, yet their independent contribution to functional recovery remains unclear.

Objective: To investigate whether preoperative psychopathology and coping styles predict functional outcome 12 months after elective spine surgery and to assess longitudinal psychosocial changes.

Methods: Of 121 eligible adults, 106 completed the 12-month follow-up (65.1% women; mean age 61.6 ± 13.1 years). The primary outcome was change in the Oswestry Disability Index (ODI; ΔODI = the baseline score minus the 12-month score), with unfavorable outcome defined as $\Delta ODI \leq 15$. Secondary outcomes included pain intensity, anxiety and depression, personality traits, and coping styles. Assessments were performed preoperatively and at 12 months postoperatively. Longitudinal changes, associations with ODI, and predictors of unfavorable outcome were analyzed.

Results: ODI improved significantly from baseline to follow-up ($p < 0.001$; $d = 0.70$), but only 22.1% of participants achieved a favorable functional improvement ($\Delta ODI > 15$). Anxiety symptoms decreased over time, whereas depressive symptoms and personality traits remained stable. Higher preoperative anxiety and depression were associated with greater postoperative pain but did not independently predict unfavorable functional outcome.

Conclusion: Elective spine surgery was associated with statistically significant improvements in disability and reduced anxiety over the 12-month follow-up period. However, only a minority of patients achieved the predefined threshold for favorable functional improvement. The findings do not support the investigated psychosocial variables as independent predictors of functional recovery but underscore

the importance of considering psychological well-being within an integrated biopsychosocial framework.

Keywords: Elective spine surgery; Oswestry Disability Index; Psychological distress; Coping strategies; Functional recovery; Biopsychosocial model

1. Introduction

Back pain is one of the most common health conditions worldwide, with lifetime prevalence rates estimated at 80%–90%.^{1–3} It occurs more frequently among women and tends to become chronic with advancing age.^{4,5} Chronic back pain not only leads to physical limitations but is also strongly associated with mental health disorders such as depression and anxiety.^{6,7}

When conservative treatments fail, surgical interventions such as decompression or fusion are often required.^{8,9} However, postoperative outcomes vary considerably, and even technically successful procedures may result in persistent pain or disability. This variability has been linked to psychosocial risk factors. Several studies indicate that depression, anxiety, and psychological distress before surgery are associated with poorer recovery and greater postoperative disability.^{10–12} Systematic reviews also highlight the role of preoperative depression and anxiety as predictors of postoperative outcomes.^{13,14} Despite this substantial body of research, findings remain inconsistent. Many studies have focused on individual predictors, such as depression or pain catastrophizing,¹⁵ whereas fewer investigations have explored the broader impact of personality traits and coping styles, although these factors may also influence how patients adapt to chronic illness and recovery.^{16–18} A more comprehensive approach that integrates multiple psychosocial dimensions may therefore provide a better understanding of recovery after spinal surgery.

Recovery after spinal surgery is increasingly understood within a biopsychosocial framework, in which physical recovery is influenced not only by surgical and disease-related factors but also by psychological distress, personality characteristics, coping resources, and social support.^{16–18} Within this conceptual model, preoperative anxiety and depressive symptoms may affect pain perception and adaptation to illness, whereas personality-related traits and coping styles may shape emotional and behavioral responses to chronic pain and postoperative rehabilitation. These interacting factors are thought to influence postoperative pain and disability and, consequently, functional recovery.

Equally important is the definition of the outcome. Previous studies have used diverse endpoints, including pain, disability, or return to work. In the present study, we defined an unfavorable outcome as limited functional improvement, operationalized as a change of ≤ 15 points on the Oswestry Disability Index (ODI),^{19,20} while pain intensity measured using the Numeric Rating Scale (NRS) was considered a secondary outcome.²¹ In addition, sex-related aspects warrant closer consideration. Women not only experience spinal pain more frequently but also show higher rates of anxiety and depression, which may affect recovery.^{4,5} Therefore, biological sex (male/female) was also examined in relation to functional and psychosocial outcomes.

The present prospective longitudinal study aimed to investigate whether preoperative psychological distress, personality-related traits, and disease-related coping styles are associated with functional recovery 12 months after elective spinal surgery. In addition, we examined longitudinal changes in psychosocial characteristics and explored potential sex-related differences in functional and psychological outcomes. Based on previous literature, we hypothesized that higher levels of preoperative anxiety and depressive symptoms, elevated dysfunctional personality traits, and maladaptive coping strategies would be associated with less favorable postoperative functional recovery, whereas adaptive coping strategies and greater social integration would be related to better outcomes. By integrating multiple psychosocial domains within a single clinical cohort, this study sought to provide a more comprehensive understanding of the complex interplay between psychological factors and postoperative recovery after spine surgery.

2. Materials and methods

2.1. Participants and measures

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments. The study protocol was reviewed and approved by the Ethics Committee of Hannover Medical School (Approval No. 1624-2012; date of approval: 2012-12-10). The study is reported in accordance with the Strengthening the Reporting of Observational Studies in

Epidemiology (STROBE) guidelines (see Supplementary File). This prospective longitudinal study was conducted at the Department of Orthopaedic Surgery, Hannover Medical School, DIAKOVERE Annastift, Hannover, in collaboration with the Department of Psychosomatic Medicine and Psychotherapy at Hannover Medical School, Hannover.

Patients were recruited between 2013 and 2015. Eligibility criteria included age ≥ 18 years and scheduled cervical or lumbar spine surgery for degenerative disease. Exclusion criteria were tumors, inflammatory diseases, physical trauma, and insufficient German language skills. Patients were recruited from the Department of Orthopedic Surgery. All eligible individuals admitted for elective spinal surgery were informed about the study by the attending physicians. Eligible patients received both oral and written information regarding the study aims and procedures and were invited to participate. Written informed consent was obtained prior to inclusion. Participants were assessed before surgery (T0) and again 12 months postoperatively (T1). The initial baseline sample comprised 121 patients. Fifteen patients did not participate in the follow-up assessment (reasons: no response, $n = 6$; refusal, $n = 7$; did not undergo the planned spine surgery, $n = 2$). Therefore, the final analytical sample comprised 106 patients ($n = 69$, 65.1% women; $n = 37$, 34.9% men) with a mean age at surgery of 61.55 years (standard deviation [SD] = 13.14, range 30–88). No a priori sample size calculation was performed because the study was designed as a prospective observational cohort study and included all eligible patients during the recruitment period. The majority underwent spinal fusion ($n = 76$, 72.4%; one missing response), and 11.4% of all procedures were in the cervical region ($n = 12$). Other procedures included lumbar microsurgery (i.e., decompression/sequestrectomy; $n = 17$, 16.2%). **Table 1** presents the detailed demographic variables of the sample and the underlying spinal pathology. Operation-related complications (type and rate) were also documented; three cases required reoperation.

The German version of the ODI [19,20] was used to assess the level of disability due to back pain. Changes in ODI total scores (Δ ODI) ≤ 15 indicate an unfavorable therapeutic outcome.²² Psychopathology was measured with the German version of the Hospital Anxiety and Depression Scale (HADS). HADS depression (HADS_{Dep}) and HADS anxiety (HADS_{Anx}) subscale scores > 10 indicate a probable depressive or anxiety disorder.²³

The Personality Disorder Screening–short version (PSS-k) was applied to assess dysfunctional personality traits. A score above the cut-off value of 6 on the PSS-k suggests the presence of at least one personality disorder.²⁴

The Essen Coping Questionnaire (ECQ) was used to assess participants' disease-related coping strategies at the emotional, cognitive, and behavioral levels. The ECQ consists of the following nine subscales: acting, problem-oriented coping, distance and self-promotion, information seeking and exchange of experiences (ISE), trivialization, wishful thinking and defense, depressive processing (DP), willingness to accept help (WAH), active search for social integration (ASS), trust in medical care, and finding of inner stability.²⁵

Table 1. Patient demographics, reason for surgery, and operation-related complications

Baseline variable	Value
Age (T0) in years, mean $\pm$ SD	61.55 $\pm$ 13.14
Sex, n (%)	
Male	37 (34.9)
Female	69 (65.1)
BMI (T0) in kg/m ² , mean $\pm$ SD ^a	28.49 $\pm$ 4.89
Education attainment (T0), n (%) ^b	
Special school/no school-leaving certificate	1 (1.0)
Lower secondary school qualification	45 (43.7)
Intermediate secondary school qualification	41 (39.8)
Higher education entrance qualification (Abitur)	16 (15.5)
Employment status (T0), n (%) ^c	
Unemployed	13 (12.3)
Employed	26 (24.5)
Retired	52 (49.1)
Unable to work	13 (12.3)
Family status (T0), n (%) ^d	
Single	30 (29.1)
Partnership	73 (70.9)
Underlying condition for surgery (T0), n (%)	
Spondylolisthesis	33 (31.1)
Osteochondrosis	32 (30.2)
Disc prolapse	13 (12.3)
Degenerative lumbar scoliosis	8 (7.5)
Post-nucleotomy syndrome	6 (5.7)
Spinal stenosis	13 (12.3)
Pseudarthrosis	1 (0.9)

(cont'd...)

Table 1. (Continued)

Baseline variable	Value
Operation-related complication (T0–T1), <i>n</i> (%) ^c	
None	89 (84.0)
Leg pain	1 (0.9)
Anemia	2 (1.9)
Unclear thrombocytopenia	1 (0.9)
Injury of the dura	1 (0.9)
Fistula of the dura	1 (0.9)
Pseudarthrosis with losing of a screw	1 (0.9)
Haemato-seroma	1 (0.9)
Spondylitis	1 (0.9)
Deep wound infection	1 (0.9)
Superficial wound infection	2 (1.9)
Reoperation	3 (2.8)

Notes: Values are presented as *n* (%) or mean $\pm$ SD, as indicated. ^aTwo missing responses; ^bthree missing responses; ^ctwo missing responses; ^dthree missing responses; ^etwo missing responses.

Pain was measured using the NRS, ranging from 0 (no pain) to 10 (most intense pain imaginable).²¹ Pain levels were recorded at rest during the night and during movement. Additionally, the expected pain level three months after surgery was assessed. All questionnaires were administered in paper-and-pencil format. Preoperatively, patients received the instruments during their hospital stay prior to surgery. At 12-month follow-up, questionnaires were mailed to participants' home addresses, and the completed questionnaires were returned in prepaid envelopes.

2.2. Data analysis

Analyses were performed using IBM® SPSS® Statistics, version 30.0 (IBM Corp., United States of America). Descriptive data are presented as means $\pm$ SD or counts and percentages. Paired *t*-tests were used to compare within-group changes in the ODI and other study variables from baseline (T0) to one-year follow-up (T1), and this analysis was conducted for the total sample as well as separately for men and women. For the paired *t*-tests, Cohen's *d* was reported as an effect size, with values > 0.2 considered small, > 0.5 moderate, and > 0.8 large.²⁶ In the total sample, bivariate two-tailed Pearson correlations of T0 and T1 ODI scores with other variables were calculated, including correlations of ODI scores with age for both men and women. Prevalence estimates of probable anxiety, depression, and personality disorders were determined from questionnaire cut-offs; McNemar's test and Cohen's *g* were used for paired categorical comparisons.^{27,28} Cohen's

g can be interpreted as follows: $0.00 < g < 0.05$ indicates a negligible effect, $0.05 \leq g < 0.15$ a small effect, $0.15 \leq g < 0.25$ a medium effect, and $g \geq 0.25$ a large effect.²⁹ To examine which preoperative psychosocial variables were associated with an unfavorable surgical outcome ($\Delta\text{ODI} \leq 15$), we performed stepwise logistic regression. We report regression coefficients (β), standard errors, Wald statistics, degrees of freedom (df), *p*-values, odds ratios, and 95% confidence intervals. To account for multiple comparisons, the significance threshold was set at $p \leq 0.01$.

Analyses were conducted using complete-case procedures based on the available data for each variable. No imputation methods were applied. Potential sources of bias, including selection bias, loss to follow-up, and missing data, were considered when interpreting the findings and are addressed in the limitations section. Consequently, the number of observations and degrees of freedom varied slightly across analyses because of occasional missing responses.

3. Results

3.1. Disability and functional outcome

Mean ODI total scores indicated a significant improvement in patients' functional status from T0 (mean = 24.02, SD = 8.96) to T1 (mean = 17.11, SD = 11.20; $t(103) = 7.14$, $p < 0.001$) with a moderate-to-large effect size ($d = 0.700$). ΔODI between T0 and T1 ranged from -18 to 37 (2 missing responses; median = 5.5; mean = 6.91; SD = 9.88). Three patients (2.9%) reported no change in ODI, 81 (77.9%) had lower postoperative ODI scores, indicating better function, and 20 (19.2%) reported higher postoperative ODI scores, indicating greater disability. Twenty-three patients (22.1%) achieved a favorable outcome ($\Delta\text{ODI} > 15$), whereas 81 (77.9%) did not ($\Delta\text{ODI} \leq 15$).

At baseline, men reported lower ODI scores than women (men: mean = 21.36, SD = 9.62; women: mean = 25.43, SD = 8.33; $t(102) = -2.24$, $p = 0.027$), although the effect size indicated a small-to-moderate difference ($d = -0.462$). One year after surgery, no sex difference was observed (mean_{male} = 15.78, SD_{male} = 11.42 vs. mean_{fem} = 17.78, SD_{fem} = 11.17; $t(104) = -0.87$, $p = 0.193$, $d = -0.178$). Changes in ODI from baseline to follow-up did not differ by sex (ΔODI : mean_{male} = 5.94, SD_{male} = 9.79 vs. mean_{fem} = 7.43, SD_{fem} = 9.96; $t(102) = -0.73$, $p = 0.235$, $d = -0.150$).

3.2. Psychosocial changes

The associations of disability with age and psychosocial variables were examined at baseline and follow-up. Baseline ODI scores were not correlated with age ($r_{\text{total}} = 0.01$, $r_{\text{male}} = 0.03$, $r_{\text{fem}} = 0.02$; all $p > 0.500$). Similarly, no association was found between ODI scores and age one year after surgery

in the total sample ($r_{\text{total}} = -0.04$, $p = 0.687$), in the male group ($r_{\text{male}} = -0.18$, $p = 0.288$) or in the female group ($r_{\text{fem}} = 0.04$, $p = 0.774$).

Pearson correlations between T0 and T1 ODI scores and psychosocial variables are displayed in Table 2. A strong correlation was found between postoperative ODI and T1 HADS_{Dep} scores ($r = 0.51$, $p < 0.001$). In contrast, a moderate-to-strong negative correlation was observed between postoperative ODI and the T1 ECQ subscale ASS ($r = -0.45$, $p < 0.001$), indicating that greater social integration was associated with lower disability and better

functional outcomes. The correlation between T0 ODI and T1 HADS_{Dep} narrowly missed the conventional threshold for a strong association but was highly significant ($r = 0.37$, $p < 0.001$). Similar patterns were observed for postoperative ODI with the T1 ECQ subscale DP ($r = 0.34$, $p = 0.001$), baseline HADS_{Dep} ($r = 0.35$, $p < 0.001$), and postoperative HADS_{Anx} ($r = 0.39$, $p < 0.001$). The remaining coefficients indicated only moderate-to-weak associations—or none—at the bivariate level.

Changes in psychopathological symptoms and disease-related coping were also examined. Mean questionnaire

Table 2. Pearson correlations of baseline and 12-month ODI scores and study variables

Variable	T0 ODI		T1 ODI
	<i>n</i>	<i>r</i>	<i>r</i>
T1 ODI	104	0.54**	–
T0 PSS-k	104	0.25*	0.18
T1 PSS-k	103	0.25*	0.23*
T0 HADS _{Anx}	104	0.21*	0.17
T1 HADS _{Anx}	103	0.29**	0.39**
T0 HADS _{Dep}	104	0.40**	0.35**
T1 HADS _{Dep}	103	0.37**	0.51**
T0 ECQ-Acting, Problem-Oriented Coping	104	–0.15	–0.19*
T1 ECQ-Acting, Problem-Oriented Coping	103	–0.16	–0.21*
T0 ECQ-Distance and Self-Promotion	104	< 0.01	–0.14
T1 ECQ-Distance and Self-Promotion	103	–0.17	–0.15
T0 ECQ-Information Seeking and Exchange of Experiences	104	0.24*	0.08
T1 ECQ-Information Seeking and Exchange of Experiences	103	0.18	0.32**
T0 ECQ-Trivialization, Wishful Thinking, and Defense	104	–0.08	–0.03
T1 ECQ-Trivialization, Wishful Thinking, and Defense	103	–0.04	–0.17
T0 ECQ-Depressive Processing	104	0.19	0.10
T1 ECQ-Depressive Processing	103	0.21*	0.34**
T0 ECQ-Willingness to Accept Help	104	0.09	–0.05
T1 ECQ-Willingness to Accept Help	103	–0.07	–0.11
T0 ECQ-Active Search for Social Integration	104	–0.25**	–0.22*
T1 ECQ-Active Search for Social Integration	103	–0.26**	–0.45**
T0 ECQ-Trust in Medical Care	104	–0.02	–0.12
T1 ECQ-Trust in Medical Care	103	–0.14	–0.23*
T0 ECQ-Finding of Inner Stability	104	–0.01	–0.04
T1 ECQ-Finding of Inner Stability	103	–0.06	–0.12

Notes: ODI = Oswestry Disability Index; PSS-k = Personality Disorder Screening-short version; HADS = Hospital Anxiety and Depression Scale; ECQ = Essen Coping Questionnaire. * $p < 0.05$ (nominal significance), ** $p < 0.01$.

scores for anxiety and depressive symptoms, personality screening, and disease-related coping styles are shown in Table 3. Mean anxiety scores decreased from baseline to follow-up, with a small-to-moderate effect size, whereas depressive symptom scores did not change significantly ($p = 0.081$). No significant changes were observed in personality traits ($p = 0.124$). The following disease-related coping strategies decreased from baseline to follow-up: ISE ($p < 0.001$; moderate effect size) and DP ($p < 0.01$; small-to-moderate effect size). A nominal decrease was observed for WAH ($p < 0.05$; small effect size), although this finding did not meet the predefined significance threshold of $p \leq 0.01$. The remaining subscales of the ECQ showed no significant changes.

Considering prevalence estimates based on categorical questionnaire cut-offs, the proportion screening positive for probable anxiety disorder decreased from 23.1% before surgery to 14.3% following surgery (McNemar's test: $p = 0.035$, Cohen's $g = 0.09$). Although this result reached nominal significance, it did not meet the predefined significance threshold of $p \leq 0.01$. No significant differences from baseline to follow-up were found for probable

depressive disorder (18.3% vs. 21.9%, McNemar's test: $p = 0.607$, Cohen's $g = 0.03$) or for the estimated prevalence of personality disorder (20.2% vs. 24.3%; McNemar's test: $p = 0.815$, Cohen's $g = 0.02$).

3.3. Pain intensity

On the NRS, the mean preoperative pain score was 4.9 (SD = 2.69) at rest during the night. During movement, pain increased to 7.1 (SD = 2.23). Participants underestimated pain intensity three months after surgery. At rest, the observed mean was 2.7 (SD = 2.50) points, exceeding the expected value of 1.5 (SD = 1.49). Under load, pain was also underestimated, with an expected value of 1.9 (SD = 1.46) points, whereas the observed three-month value was 3.9 (SD = 2.68). At 12 months, mean pain intensity was 2.7 (SD = 2.52) at rest and 4.3 (SD = 3.00) under load. Descriptive statistics for pain intensity across all assessment time points are presented in Table 4. Overall, mean pain levels decreased over time, although participants tended to underestimate their postoperative pain intensity at three months, both at rest and under load.

Preoperative pain intensity correlated significantly

Table 3. Pre-post comparison of psychosocial variables

Variable	T0	T1	Pre-post comparison	
	mean (SD)	mean (SD)	<i>t</i> (df)	Cohen's <i>d</i>
HADS _{Anx}	7.53 (3.97)	6.16 (3.94)	4.29(102)***	0.423
HADS _{Dep}	6.88 (4.12)	6.27 (4.50)	1.76(102)	0.174
PSS-k	4.48 (3.16)	4.07 (3.19)	1.55(102)	0.153
ECQ-Acting, Problem-oriented Coping	2.17 (0.82)	2.24 (0.93)	-0.76(102)	-0.074
ECQ-Distance and Self-Promotion	1.98 (0.71)	1.97 (0.80)	0.30(102)	0.029
ECQ-Information Seeking and Exchange of Experiences	1.54 (0.90)	1.04 (0.92)	5.91(102)***	0.582
ECQ-Trivialization, Wishful Thinking and Defense	1.37 (0.69)	1.30 (0.74)	0.89(102)	0.088
ECQ-Depressive Processing	1.03 (0.82)	0.80 (0.83)	3.22(102)**	0.317
ECQ-Willingness to Accept Help	1.63 (0.71)	1.50 (0.70)	2.21(102)	0.218
ECQ-Active Search for Social Integration	1.62 (0.81)	1.71 (0.91)	-1.24(102)	-0.122
ECQ-Trust in Medical Care	3.13 (0.58)	3.01 (0.67)	0.80(102)	0.079
ECQ-Finding of Inner Stability	1.13 (0.82)	1.11 (0.75)	0.42(102)	0.16

Notes: PSS-k = Personality Disorder Screening-short version; HADS = Hospital Anxiety and Depression Scale; ECQ = Essen Coping Questionnaire. ** $p < 0.01$; *** $p < 0.001$.

with both the T0 ODI score and postoperative pain intensity. The T1 ODI score showed strong associations with both preoperative and postoperative pain levels. Additionally, higher preoperative anxiety and depression scores were linked to greater postoperative pain. Among coping strategies, DP (T1 ECQ subscale) was significantly associated with increased postoperative disability and pain, whereas ASS (T1 ECQ subscale) was negatively associated with postoperative pain. The full correlation table is provided in [Table A1](#).

Table 4. Pain intensity ratings across assessment time points

Pain variable	Mean (SD)
Preoperative pain at rest during the night (T0)	4.9 (2.69)
Preoperative pain during movement (T0)	7.1 (2.23)
Expected pain at rest, 3 months after surgery	1.5 (1.49)
Observed pain at rest, 3 months after surgery	2.7 (2.50)
Expected pain under load, 3 months after surgery	1.9 (1.46)
Observed pain under load, 3 months after surgery	3.9 (2.68)
Pain at rest, 12-month follow-up (T1)	2.7 (2.52)
Pain under load, 12-month follow-up (T1)	4.3 (3.00)

Notes: NRS = Numeric Rating Scale. Pain intensity was rated on a scale from 0 (no pain) to 10 (worst imaginable pain).

3.3. Exploratory regression analysis

To examine which preoperative psychosocial variables were associated with an unfavorable surgical outcome ($\Delta\text{ODI} \leq 15$), we conducted a stepwise logistic regression analysis. The dependent variable was $\Delta\text{ODI} \leq 15$ (1 = unfavorable

outcome) versus $\Delta\text{ODI} > 15$ (0 = favorable outcome). Variable selection was theory-driven and informed by previous literature demonstrating associations between psychological distress and postoperative outcomes after spine surgery.^{13,14,16-18} Biological sex was included in the first step as a clinically relevant covariate because previous studies have reported sex-related differences in pain perception, psychological distress, and postoperative outcomes after spine surgery.^{4,5,30-33} In the second step, preoperative PSS-k, HADS_{Anx}, and HADS_{Dep} scores were entered, as these variables represented the principal psychosocial domains investigated in the present study and were derived directly from the study aims and hypotheses. Given the exploratory nature of the analyses and the relatively modest sample size, a stepwise approach was chosen to identify variables contributing additional explanatory value. Neither sex nor any preoperative psychosocial variable was significantly associated with unfavorable functional outcome ($\Delta\text{ODI} \leq 15$). The results of the exploratory logistic regression analysis are presented in [Table 5](#).

4. Discussion

In the present sample, higher levels of impaired functional status and reduced quality of life due to chronic back pain were related to depressive symptoms both before and after spinal surgery. Our findings also indicate that elevated preoperative anxiety and depression are associated with greater postoperative pain intensity, which suggests a bidirectional relationship between psychological distress and functional limitations. This pattern supports previous research highlighting the reciprocal interaction between mental health and physical recovery in chronic back pain.³⁴⁻³⁷

Several systematic reviews^{13,14} consistently report that preoperative depressive symptoms predict higher

Table 5. Exploratory logistic regression analysis of unfavorable functional outcome ($\Delta\text{ODI} \leq 15$)

Variable	β	SE	Wald	df	<i>p</i>	Odds ratio	95% CI	Nagelkerke <i>R</i> ²
Step 1	Sex	-0.77	0.56	1.92	1	0.166	0.46	0.16, 1.38
	Sex	-0.86	0.59	2.12	1	0.145	0.42	0.13, 1.35
Step 2	PSS-k	-0.10	0.10	0.99	1	0.320	0.91	0.74, 1.10
	HADS _{Anx}	0.08	0.09	0.82	1	0.366	1.08	0.91, 1.29
	HADS _{Dep}	0.02	0.08	0.07	1	0.792	1.02	0.87, 1.21

Notes: β = Regression coefficient; SE = Standard error; df = Degrees of freedom; CI = Confidence interval; ODI = Oswestry Disability Index; PSS-k = Personality Disorder Screening–short version; HADS = Hospital Anxiety and Depression Scale.

postoperative disability and more persistent pain, which aligns with our observation of significant correlations between depressive scores and ODI outcomes. However, several factors may explain why preoperative anxiety and depression were associated with postoperative pain but did not independently predict unfavorable functional outcomes. In addition to the relatively modest sample size and the conservative ODI threshold used to define favorable recovery, the heterogeneous clinical composition of the cohort, including different spinal regions and surgical procedures, and the absence of several clinically relevant covariates in the regression model may have reduced the ability to detect independent effects of individual psychosocial variables.

Notably, the relevance of psychological distress extends beyond functional recovery. Patients entering surgery with depressive symptoms often begin from a worse baseline, yet their amount of postoperative improvement is comparable to that of non-depressed patients. When baseline severity and other covariates are accounted for, depression can therefore contribute less unique variance to change scores such as Δ ODI.³⁸ This suggests that while affective symptoms influence recovery, their prognostic power may be limited when multiple psychosocial and clinical factors are considered simultaneously.

The interpretation of these findings should also take into account the definition of favorable outcome used in the present study. Consistent with previous recommendations, a change in ODI greater than 15 points was selected a priori as an indicator of clinically meaningful improvement.²² Although this threshold facilitates comparison with previous studies, the relatively modest baseline disability observed in our cohort may have reduced the proportion of patients able to achieve this criterion. Accordingly, the low percentage of patients classified as having a favorable outcome should be interpreted in the context of the comparatively low baseline ODI scores and suggests that the selected threshold represented a relatively conservative definition of postoperative functional recovery in this cohort.

A possible explanation for this finding is that depressive and anxiety symptoms fluctuate over time and may improve as patients experience pain relief and regain physical function after surgery. In our sample, anxiety levels showed a decrease from baseline to follow-up. Although the reduction in categorical anxiety prevalence reached nominal significance ($p = 0.035$), it did not meet the predefined significance threshold of $p \leq 0.01$. Nevertheless, this pattern suggests that psychological well-being may improve during the postoperative course, potentially in parallel with pain relief and functional recovery. This

observation underscores the relevance of integrating psychosocial care and comprehensive preoperative education into surgical management, as previous research has shown that informed and reassured patients tend to experience better mental health and functional outcomes.³⁹ Changes in coping strategies further illustrate the dynamic adjustment process after surgery. Although coping styles such as ISE and DP changed significantly over time, they did not independently predict functional outcome. This pattern suggests that coping mechanisms may influence postoperative recovery through more complex pathways rather than acting as direct predictors of outcome. Prior studies on maladaptive coping, particularly pain catastrophizing,¹⁵ have reported similar indirect associations, reinforcing the idea that psychological adaptation plays a nuanced role in recovery. Accordingly, enhancing adaptive coping resources—such as social connectedness and self-efficacy—may support sustained rehabilitation.

Sex-stratified analyses added relevant nuance to these findings. Although women exhibited significantly greater disability at baseline, this difference was no longer apparent at the 12-month follow-up, and the magnitude of functional improvement (Δ ODI) was comparable across sexes. Associations between psychosocial factors and postoperative disability were also similar in men and women, suggesting largely sex-independent psychological influences on recovery. These patterns align with evidence showing that observed sex differences in postoperative outcomes often diminish once baseline status is accounted for, as demonstrated in recent large-scale analyses.^{30–33}

Overall, the present findings indicate that postoperative recovery after spine surgery is influenced by the interaction between psychological distress, coping resources, and physical factors. Although preoperative mental health status was associated with postoperative disability and pain, it did not independently predict functional recovery. Therefore, postoperative outcome is likely determined by multiple interacting psychosocial and clinical factors rather than by isolated psychological variables. An interdisciplinary biopsychosocial approach that addresses both physical and psychological aspects of recovery therefore appears particularly relevant. Such a framework—integrating surgical, psychological, and rehabilitative care—has been repeatedly advocated in recent literature and is supported by our findings.^{17,18}

Previous evidence suggests that depressive symptoms may also be associated with postoperative complications and reoperations.³³ From a clinical perspective, these findings do not support the use of the investigated psychosocial variables as stand-alone prognostic markers.

However, they emphasize the importance of integrating psychological aspects into routine perioperative care. Interdisciplinary management involving spine surgeons, rehabilitation specialists, and mental health professionals may help to identify patients with elevated psychological distress and provide supportive interventions before and after surgery.¹¹ Potential supportive measures include structured patient education, psychological counseling, and interventions aimed at promoting adaptive coping, social support, and self-efficacy.^{11,39} Rather than representing a validated prognostic screening approach, these measures may contribute to a more comprehensive biopsychosocial management of postoperative recovery.^{3,14,38}

5. Limitations

Several limitations should be considered when interpreting the present findings. First, no a priori sample size calculation was performed because the study was designed as a prospective observational cohort study and included all eligible patients during the recruitment period. Consequently, the sample size was relatively modest, which may have limited the statistical power to detect small effect sizes, particularly in the exploratory regression analyses. In addition, the relatively small number of participants classified as having a favorable outcome may have reduced the ability to detect small-to-moderate associations. Although the sample size was comparable to that of previous studies investigating psychosocial factors in spine surgery, larger cohorts are needed to confirm the present findings. Furthermore, because no formal comparison between participants who completed the 12-month follow-up and those lost to follow-up was performed, potential attrition bias cannot be excluded and should be considered when interpreting the present findings.

Second, the definition of favorable outcome based on a change in ODI greater than 15 points represented a relatively conservative threshold. Given the comparatively low baseline disability observed in the present cohort, this criterion may have reduced the proportion of patients classified as having a favorable outcome and thereby limited the statistical power of the regression analyses.

Third, the regression model focused primarily on psychosocial variables and did not include several clinically relevant factors, such as baseline disability, pain intensity, age, type of surgery, spinal region, or postoperative complications. Given the relatively small number of participants who achieved a favorable functional outcome ($n = 23$), additional clinical covariates were not entered into the regression model to reduce the risk of model overfitting. In addition, the heterogeneous clinical composition of the cohort, including different surgical

procedures and spinal regions, may have contributed to variability in postoperative recovery. Consequently, the regression analyses should be considered exploratory, and the observed associations should be interpreted with caution.

Fourth, all psychosocial variables were assessed using self-report questionnaires, which may have introduced response bias and limited the objectivity of the data. Future studies could benefit from including clinician-rated assessments or structured diagnostic interviews to complement self-reported measures of anxiety, depression, and personality traits.

Finally, although this was a prospective longitudinal study, causal inferences should be drawn with caution. The associations observed between psychological factors and postoperative outcomes do not necessarily imply direct causality. Furthermore, none of the investigated psychosocial variables reached statistical significance in the regression analyses, and the explained variance was low (Nagelkerke $R^2 = 0.08$). Therefore, the present findings do not support the establishment of a clinically useful prediction model. Future studies with larger samples and the integration of both psychosocial and clinical variables are needed to develop and validate more comprehensive models of postoperative recovery.

6. Conclusion

The interplay between depression, anxiety, and functional limitations should be carefully considered when planning and delivering surgical treatment for patients with back pain. Although disability scores improved significantly over the 12-month follow-up period, only a minority of patients achieved the predefined threshold for favorable functional improvement. The present findings do not support the use of the investigated psychosocial variables as independent predictors of functional recovery. However, they underscore the importance of considering psychological well-being within an interdisciplinary biopsychosocial framework. Integrating psychosocial assessment alongside surgical and rehabilitative care may contribute to a more comprehensive approach to postoperative recovery.

Future research should also investigate whether structured psychological support programs and coping-focused interventions implemented in the preoperative and postoperative setting can enhance recovery and patient-reported outcomes after spine surgery and help to identify which patients are most likely to benefit from such interventions.

Acknowledgments

None.

Funding

None.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Author contributions

Conceptualization: Dorothea Daentzer, Astrid Müller

Data curation: Johanna Tendai Zishiri, Friederike Weidemann

Formal analysis: Nora M. Laskowski, Friederike Weidemann

Investigation: Johanna Tendai Zishiri

Methodology: Astrid Müller, Dorothea Daentzer

Project administration: Dorothea Daentzer

Resources: Dorothea Daentzer

Software: Nora M. Laskowski

Supervision: Dorothea Daentzer, Astrid Müller

Validation: Nora M. Laskowski, Friederike Weidemann

Writing—original draft: Friederike Weidemann, Nora M. Laskowski

Writing—review & editing: All authors

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments. The study protocol was reviewed and approved by the Ethics Committee of Hannover Medical School (Approval No. 1624-2012; date of approval: December 10, 2012). Eligible patients received both oral and written information regarding the study aims and procedures and were invited to participate. Written informed consent was obtained before inclusion.

Consent for publication

Written informed consent was obtained from all participants for the publication of their anonymized data and questionnaire results.

Availability of data

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and data protection requirements.

Further disclosure

No artificial intelligence (AI) tools were used in the preparation of this manuscript. Accordingly, no AI-assisted language editing, content generation, or other AI-supported processes were involved. All aspects of the

manuscript, including writing, study design, data analysis and interpretation, and the formulation of conclusions, were carried out exclusively by the authors. Parts of the results of this study were presented in an oral presentation entitled “Postoperative Satisfaction in Patients Following Elective Spine Surgery” (original German title: “Postoperative Zufriedenheit bei Patienten nach elektiver Wirbelsäulenoperation”) at the German Spine Congress (Deutscher Wirbelsäulenkongress), held in Wiesbaden, Germany, from December 10 to 12, 2025.

References

- Schmidt CO, Kohlmann T. Backache in Germany: an epidemiological review - 80 to 90 % of the German population are affected during their lifetime. *Klinikerzt*. 2007;36(12):680-684.
doi: 10.1055/s-2007-1021785
- von der Lippe E, Krause L, Porst M, et al. Prevalence of back and neck pain in Germany. Results from the BURDEN 2020 Burden of Disease Study. *J Health Monit*. 2021;6(suppl 3):2-14.
doi: 10.25646/7855
- Neuhauser H, Ellert U, Ziese T. Chronische Rückenschmerzen in der Allgemeinbevölkerung in Deutschland 2002/2003: Prävalenz und besonders betroffene Bevölkerungsgruppen [Chronic back pain in the general population in Germany 2002/2003: prevalence and highly affected population groups]. *Gesundheitswesen*. 2005;67(10):685-693.
doi: 10.1055/s-2005-858701
- Bento TPF, Genebra CVDS, Maciel NM, Cornelio GP, Simeão SFAP, Vitta A. Low back pain and some associated factors: is there any difference between genders? *Braz J Phys Ther*. 2020;24(1):79-87.
doi: 10.1016/j.bjpt.2019.01.012
- Schüssel K, Weirauch H, Schlotmann A, Ashrafiyan S, Brückner G, Schröder H. Gesundheitsatlas Deutschland: Rückenschmerzen: Verbreitung in der Bevölkerung Deutschlands: Ursachen, Folgen und Präventionsmöglichkeiten [Health Atlas Germany: Prevalence of back pain in the German population: Causes, consequences, and prevention strategies]. Berlin, Germany: Wissenschaftliches Institut der AOK (WIdO); 2023.
doi: 10.4126/FRL01-006453981
- Martini L, Hoffmann F. Comorbidity of chronic back pain and depression in Germany: Results from the GEDA study, 2009 and 2010. *Z Evid Fortbild Qual Gesundhwes*. 2018;137-138:62-68.
doi: 10.1016/j.zefq.2018.10.003
- Schmidt C, Bernert S, Spyra K. Zur Relevanz psychischer Komorbiditäten bei chronischem Rückenschmerz:

- Häufigkeitsbild, Erwerbsminderungsrenten und Reha-Nachsorge im Zeitverlauf der Reha-Kohorten 2002–2009 [Concerning the impact of psychological comorbidity for chronic back pain: frequency, reduced earning capacity pension and rehabilitation aftercare in the course of the rehabilitation cohorts 2002–2009]. *Rehabilitation (Stuttg)*. 2014;53(6):384–389.
doi: 10.1055/s-0034-1394449
8. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical versus non-surgical treatment for lumbar spinal stenosis. *Cochrane Database Syst Rev*. 2016;2016(1):CD010264.
doi: 10.1002/14651858.CD010264.pub2
 9. Friis Pedersen C, Eiskjær S, Østerheden Andersen M, Yacat Carreon L, Doering P. A propensity-matched study of patients with symptomatic lumbar spinal stenosis opting for surgery versus not. *Brain Spine*. 2024;4:102802.
doi: 10.1016/j.bas.2024.102802
 10. Bailey EA, Wirtalla C, Sharoky CE, Kelz RR. Disparities in operative outcomes in patients with comorbid mental illness. *Surgery*. 2018;163(4):667–671.
doi: 10.1016/j.surg.2017.09.029
 11. Levett DZH, Grimmett C. Psychological factors, prehabilitation and surgical outcomes: evidence and future directions. *Anaesthesia*. 2019;74(suppl 1):36–42.
doi: 10.1111/anae.14507
 12. Amaral V, Marchi L, Martim H, et al. Influence of psychosocial distress in the results of elective lumbar spine surgery. *J Spine Surg*. 2017;3(3):371–378.
doi: 10.21037/jss.2017.08.05
 13. Morales A, El Chamaa A, Mehta S, Rushton A, Battié MC. Depression as a prognostic factor for lumbar spinal stenosis outcomes: a systematic review. *Eur Spine J*. 2024;33(3):851–871.
doi: 10.1007/s00586-023-08002-x
 14. Strøm J, Bjerrum MB, Nielsen CV, et al. Anxiety and depression in spine surgery—a systematic integrative review. *Spine J*. 2018;18(7):1272–1285.
doi: 10.1016/j.spinee.2018.03.017
 15. Kim HJ, Park JW, Chang BS, Lee CK, Yeom JS. The influence of catastrophising on treatment outcomes after surgery for lumbar spinal stenosis. *Bone Joint J*. 2015;97-B(11):1546–1554.
doi: 10.1302/0301-620X.97B11.36016
 16. Yamamoto Y, Kawakami M, Minetama M, et al. Psychological predictors of satisfaction after lumbar surgery for lumbar spinal stenosis. *Asian Spine J*. 2022;16(2):270–278.
doi: 10.31616/asj.2020.0402
 17. Rahman R, Ibaseta A, Reidler JS, et al. Changes in patients' depression and anxiety associated with changes in patient-reported outcomes after spine surgery. *J Neurosurg Spine*. 2020;32(6):871–890.
doi: 10.3171/2019.11.SPINE19586
 18. Bellosta-López P, Mandelli F, Langella F, et al. The influence of peri-operative depressive symptoms on medium-term spine surgery outcome: a prospective study. *Eur Spine J*. 2023;32(10):3394–3402.
doi: 10.1007/s00586-023-07875-2
 19. Mannion AF, Junge A, Fairbank JC, Dvorak J, Grob D. Development of a German version of the Oswestry Disability Index. Part 1: cross-cultural adaptation, reliability, and validity. *Eur Spine J*. 2006;15(1):55–65.
doi: 10.1007/s00586-004-0815-0
 20. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)*. 2000;25(22):2940–2952.
doi: 10.1097/00007632-200011150-00017
 21. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken)*. 2011;63(suppl 11):S240–S252.
doi: 10.1002/acr.20543
 22. Davidson M, Keating JL. A comparison of five low back disability questionnaires: reliability and responsiveness. *Phys Ther*. 2002;82(1):8–24.
doi: 10.1093/ptj/82.1.8
 23. Herrmann-Lingen C, Buss U, Snaith RP. *Hospital Anxiety and Depression Scale: Deutsche Version*. Bern, Switzerland: Huber; 2011.
 24. Schöttke H, Lange J, Imholz M, Wiedl KH. Development of a screening measure for the assessment of personality disorders: The Personality Disorder Screening—short version (PSS-K). *Verhaltenstherapie*. 2011;21(3):154–161.
doi: 10.1159/000329747
 25. Franke GH, Jagla-Franke M. *Essen Coping Questionnaire (ECQ): English Version—Test Manual*. Göttingen, Germany: Psychometrikon; 2016.
doi: 10.6099/1000300
 26. Cohen J, Cohen P, West SG, Aiken LS. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. Mahwah, NJ: Lawrence Erlbaum Associates; 2003.
 27. Sundjaja JH, Shrestha R, Krishan K. McNemar and Mann-Whitney U Tests. In: *StatPearls* [Internet]. Treasure Island, FL: StatPearls Publishing; 2026. Updated July 17, 2023. Accessed December 15, 2024.

28. Hedges LV. Distribution theory for Glass's estimator of effect size and related estimators. *J Educ Stat.* 1981;6(2):107-128.
doi: 10.3102/10769986006002107
29. Cohen J. The statistical power of abnormal-social psychological research: a review. *J Abnorm Soc Psychol.* 1962;65(3):145-153.
doi: 10.1037/h0045186
30. Siccoli A, Staartjes VE, de Wispelaere MP, Schröder ML. Gender differences in degenerative spine surgery: Do female patients really fare worse? *Eur Spine J.* 2018;27(10):2427-2435.
doi: 10.1007/s00586-018-5737-3
31. MacLean MA, Charest-Morin R, Stratton A, *et al.* Gender differences in spine surgery for degenerative lumbar disease: prospective cohort study. *J Neurosurg Spine.* 2024;42(1):24-32.
doi: 10.3171/2024.7.SPINE231388
32. Salamanna F, Contartese D, Tschon M, *et al.* Sex and gender determinants following spinal fusion surgery: a systematic review of clinical data. *Front Surg.* 2022;9:983931.
doi: 10.3389/fsurg.2022.983931
33. Aghajanian S, Shafiee A, Teymouri Athar MM, *et al.* Impact of depression on postoperative medical and surgical outcomes in spine surgeries: a systematic review and meta-analysis. *J Clin Med.* 2024;13(11):3247.
doi: 10.3390/jcm13113247
34. Roughan WH, Campos AI, García-Marín LM, *et al.* Comorbid chronic pain and depression: shared risk factors and differential antidepressant effectiveness. *Front Psychiatry.* 2021;12:643609.
doi: 10.3389/fpsyt.2021.643609
35. Yang H, Hurwitz EL, Li J, *et al.* Bidirectional comorbid associations between back pain and major depression in US adults. *Int J Environ Res Public Health.* 2023;20(5):4217.
doi: 10.3390/ijerph20054217
36. Yao C, Zhang Y, Lu P, *et al.* Exploring the bidirectional relationship between pain and mental disorders: a comprehensive Mendelian randomization study. *J Headache Pain.* 2023;24(1):82.
doi: 10.1186/s10194-023-01612-2
37. Werneck AO, Stubbs B. Bidirectional relationship between chronic pain and depressive symptoms in middle-aged and older adults. *Gen Hosp Psychiatry.* 2024;89:49-54.
doi: 10.1016/j.genhosppsych.2024.05.007
38. Javeed S, Benedict B, Yakdan S, *et al.* Implications of preoperative depression for lumbar spine surgery outcomes: a systematic review and meta-analysis. *JAMA Netw Open.* 2024;7(1):e2348565.
doi: 10.1001/jamanetworkopen.2023.48565
39. Darville-Beneby R, Lomanowska AM, Yu HC, *et al.* The impact of preoperative patient education on postoperative pain, opioid use, and psychological outcomes: a narrative review. *Can J Pain.* 2023;7(2):2266751.
doi: 10.1080/24740527.2023.2266751

Appendix

Table A1. Correlations between numeric rating scale scores and study variables

Variable	T0 NRS		T1 NRS	
	<i>n</i>	<i>r</i>	<i>n</i>	<i>r</i>
T1 NRS	103	0.315**	–	
T0 ODI	103	0.477**	0.314**	
T1 ODI	104	0.337**	0.740**	
T0 PSS-k	104	0.223*	0.200*	
T1 PSS-k	103	0.205*	0.184	
T0 HADS-Anxiety	104	0.269**	0.231*	
T1 HADS-Anxiety	103	0.332**	0.404**	
T0 HADS-Depression	104	0.300**	0.298**	
T1 HADS-Depression	103	0.273**	0.498**	
T0 ECQ-Acting, problem-oriented coping	104	0.014	–0.135	
T1 ECQ-Acting, problem-oriented coping	103	0.009	–0.128	
T0 ECQ-Distance and self-promotion	104	0.121	–0.090	
T1 ECQ-Distance and self-promotion	103	0.060	–0.010	
T0 ECQ-Information seeking and exchange of experiences	104	0.136	–0.040	
T1 ECQ-Information seeking and exchange of experiences	103	0.175	0.262**	
T0 ECQ-Trivialization, wishful thinking and defense	104	0.067	0.002	
T1 ECQ-Trivialization, wishful thinking and defense	103	0.220*	–0.044	
T0 ECQ-Depressive processing	104	0.137	0.085	
T1 ECQ-Depressive processing	103	0.212*	0.394**	
T0 ECQ-Willingness to accept help	104	0.208*	–0.049	
T1 ECQ-Willingness to accept help	103	0.032	–0.080	
T0 ECQ-Active search for social integration	104	–0.046	–0.158	
T1 ECQ-Active search for social integration	103	–0.050	–0.314**	
T0 ECQ-Trust in medical care	104	0.065	–0.128	
T1 ECQ-Trust in medical care	103	0.007	–0.211	
T0 ECQ-Finding of inner stability	104	0.110	0.016	
T1 ECQ-Finding of inner stability	103	0.061	–0.094	

Notes: T0 = baseline; T1 = 12-month follow-up; *n* = number of observations; *r* = Pearson correlation coefficient; NRS = Numeric Rating Scale; ODI = Oswestry Disability Index; PSS-k = Personality Disorder Screening-short version; HADS = Hospital Anxiety and Depression Scale; ECQ = Essen Coping Questionnaire. **p* < 0.05 (nominal significance); ***p* < 0.01.