Journal of Physiotherapy and Occupational Rehabilitation

JPOR 2025; 1(2): 25-30
www.occupationaljournal.com
Received: 06-08-2025
Accepted: 10-09-2025

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Evaluating behavioral rehabilitation approaches for improving treatment adherence in employees with chronic pain

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Abstract
Chronic pain remains a significant occupational health concern that affects employee well-being, productivity, and long-term work participation. This study evaluates the effectiveness of behavioral rehabilitation approaches in improving treatment adherence and clinical outcomes among employees with chronic pain, comparing a structured multimodal behavioral intervention with conventional care. A quasi-experimental design was adopted, enrolling 120 participants who were allocated into behavioral rehabilitation and conventional care groups using stratified procedures. The behavioral intervention integrated cognitive-behavioral therapy, graded activity, operant conditioning strategies, and motivational interviewing, while the control group received standard pharmacological management and routine physiotherapy. Outcomes measured at baseline and after eight weeks included treatment adherence, pain intensity, pain catastrophizing, fear-avoidance beliefs, and self-efficacy levels. Additional workplace-related variables such as supervisor support and job flexibility were assessed as potential moderators of adherence. Results indicated significantly higher adherence in the behavioral rehabilitation group compared with the conventional care group, accompanied by larger reductions in pain intensity and maladaptive cognitions as well as greater improvements in self-efficacy. Weekly adherence patterns demonstrated sustained engagement in the behavioral group, whereas the conventional care group showed a progressive decline. Regression analyses confirmed that adherence was a significant predictor of clinical improvement, and supportive workplace environments enhanced engagement and recovery. At three-month follow-up, employees receiving behavioral rehabilitation exhibited higher return-to-work rates, suggesting that integrating psychological and behavioral components within occupational health frameworks can produce durable functional gains. Overall, the findings highlight the need for comprehensive, behaviorally oriented pain management strategies that address both individual and contextual determinants of adherence. The study contributes to the growing evidence supporting the inclusion of behavioral rehabilitation within workplace health systems, offering a promising pathway for improving treatment continuity, reducing disability, and promoting long-term employee well-being.

Keywords: Behavioral rehabilitation, chronic pain, treatment adherence, cognitive-behavioral therapy, graded activity, operant conditioning, motivational interviewing, occupational health, pain management, workplace support, self-efficacy, fear-avoidance, return to work, employee well-being, biopsychosocial approach

Introduction
Chronic pain is a growing occupational health challenge affecting functional capacity, productivity, and long-term employability, with global prevalence estimates indicating that nearly one in five adults experiences persistent pain lasting longer than three months [1, 2]. Among working populations, chronic musculoskeletal, neuropathic, and stress-related pain conditions are strongly associated with absenteeism, presenteeism, psychological distress, and reduced work performance [3-5]. Behavioral rehabilitation approaches—such as cognitive-behavioral therapy (CBT), operant conditioning, graded activity, motivational interviewing, and self-management training—have been increasingly integrated into occupational health programs to enhance treatment adherence and improve functional outcomes in employees with chronic pain [6-9]. Evidence suggests that poor adherence to pharmacological and non-pharmacological interventions remains a major barrier to effective pain management, often influenced by employee beliefs, workplace stressors, organizational

culture, and inadequate support systems [10-12]. Studies demonstrate that psychological factors such as catastrophizing, fear-avoidance, and low self-efficacy significantly predict non-adherence and delayed recovery [13-15], while structured behavioral interventions have been shown to improve coping strategies, increase engagement in therapy, and facilitate sustained behavioral change [16-18]. Despite these promising findings, there is limited research focusing specifically on how integrated behavioral rehabilitation models function within real-world occupational settings, where employees often navigate competing demands, productivity pressures, and stigma related to pain disclosure [19-21]. This creates a critical gap in understanding the contextual determinants that shape adherence behaviors and the extent to which multimodal behavioral rehabilitation can enhance treatment compliance and return-to-work readiness [22, 23]. Accordingly, the present study aims to evaluate the effectiveness of selected behavioral rehabilitation approaches in improving treatment adherence among employees with chronic pain, examining both individual-level psychological factors and workplace-related influences. The study objectives are: (i) to assess the impact of behavioral rehabilitation on adherence to prescribed therapeutic regimens; (ii) to determine the relationship between psychological determinants and adherence behavior; and (iii) to examine whether workplace-support mechanisms moderate adherence outcomes. Based on prior literature indicating that behavioral interventions enhance motivation and self-management in chronic pain patients [24-27], the study hypothesizes that employees receiving structured behavioral rehabilitation will demonstrate significantly higher treatment adherence compared to those receiving conventional care alone. Additionally, it is hypothesized that psychological readiness and organizational support will positively mediate the effectiveness of behavioral rehabilitation strategies [28, 29].

Materials and Methods

Materials

The study population consisted of full-time employees aged 25-60 years who had been clinically diagnosed with chronic pain persisting for more than three months, consistent with established epidemiological criteria [1, 2]. Participants were recruited from corporate occupational health units and workplace wellness clinics that commonly report musculoskeletal and stress-related pain conditions among employees [3-5]. Baseline assessment tools included validated chronic pain questionnaires, psychological screening scales, and functional disability inventories aligned with behavioral rehabilitation research standards [6-8]. Pain intensity was evaluated using the Numerical Rating Scale (NRS), while psychological measures included the Pain Catastrophizing Scale, Fear-Avoidance Beliefs Questionnaire, and General Self-Efficacy Scale, reflecting the central role of psychosocial factors in chronic pain behavior [13-15]. Behavioral rehabilitation materials consisted of structured cognitive-behavioral therapy modules, graded activity manuals, operant conditioning worksheets, and motivational interviewing guidelines derived from widely accepted chronic pain rehabilitation frameworks [7-9, 16-18]. Organizational support was documented using workplace readiness and supervisor support indices, given the established influence of environmental and occupational determinants on treatment adherence [19-21]. All assessment instruments and intervention materials were standardized, peer-reviewed, and validated in previous studies examining chronic pain, rehabilitation effectiveness, and return-to-work outcomes [22-24]. Ethical approval was obtained from the institutional review board overseeing occupational health interventions, and all participants provided informed consent prior to enrollment, in accordance with global guidelines on chronic pain research ethics [10-12].

Methods

This study employed a quasi-experimental design with two parallel groups: the behavioral rehabilitation group and the conventional care group, following established models of comparative pain intervention research [24-27]. Participants were assigned to groups using stratified allocation based on age, pain duration, and job category to ensure demographic balance. The behavioral rehabilitation group received an integrated multimodal intervention comprising CBT-based coping skills training, operant conditioning strategies, graded activity progression, and motivational interviewing sessions delivered over eight weeks by certified therapists experienced in chronic pain management [6-9, 16-18]. The control group received standard clinical care, including pharmacological treatment and routine physiotherapy, consistent with occupational health guidelines [3-5]. Treatment adherence was measured weekly using a validated adherence checklist and digital therapy-engagement tracker, in line with WHO adherence assessment frameworks [10, 11]. Secondary outcomes included changes in pain intensity, psychological variables, and functional limitations, measured at baseline and post-intervention. Workplace factors—such as supervisor support, job flexibility, and workload—were analyzed as potential moderators of adherence outcomes based on validated occupational models [19-21, 28, 29]. Statistical analysis included paired and independent t-tests, chi-square tests, and multivariate regression to evaluate group differences and predictive relationships, consistent with methodological recommendations for pain rehabilitation research [22-24]. All analyses were conducted using a 95% confidence interval, and effect sizes were calculated to determine clinical relevance in accordance with best practices in behavioral pain research methodology [26, 27].

Results

Overall Treatment Adherence

A total of 120 employees with chronic pain were included in the analysis (behavioral rehabilitation group, n = 60; conventional care group, n = 60). Baseline sociodemographic and clinical characteristics were comparable between groups, with no statistically significant differences in age, sex distribution, pain duration, job category, or baseline pain intensity and psychosocial scores (Table 1), consistent with prior occupational chronic pain cohorts [1-5, 13-15].

Table 1: Baseline sociodemographic and clinical characteristics of participants (n = 120)

Variable	Behavioral rehabilitation (n = 60)	Conventional care (n = 60)	*p* value
Age, years, mean ± SD	41.3 ± 8.2	42.1 ± 7.9	0.54
Female, n (%)	32 (53.3)	30 (50.0)	0.71
Pain duration, months, median (IQR)	18 (12-30)	19 (11-28)	0.63
Job category (sedentary), n (%)	38 (63.3)	36 (60.0)	0.71
Baseline NRS pain (0-10), mean ± SD	7.2 ± 1.1	7.1 ± 1.0	0.68
Pain Catastrophizing Scale, mean ± SD	29.0 ± 8.1	28.4 ± 7.6	0.72
Fear-Avoidance Beliefs Questionnaire, mean ± SD	22.5 ± 6.9	23.1 ± 7.2	0.64
General Self-Efficacy Scale, mean ± SD	24.7 ± 5.8	24.2 ± 6.0	0.70

Adherence to the prescribed treatment regimen over the 8-week intervention period was significantly higher in the behavioral rehabilitation group compared with the conventional care group. Mean overall adherence (percentage of scheduled sessions completed) was 86.1% ± 9.3 in the behavioral rehabilitation group versus 63.2% ± 12.1 in the conventional care group (independent *t*-test, $p < 0.001$), in line with earlier reports that structured behavioral interventions enhance engagement and continuity in chronic pain management [6-12, 16-18, 24-27]. Weekly adherence trajectories (Figure 1) showed a progressive increase and stabilization in the behavioral rehabilitation group, while adherence in the conventional care group declined slightly over time, suggesting that the multimodal behavioral framework supported sustained participation despite ongoing work demands [19-21, 22-24].

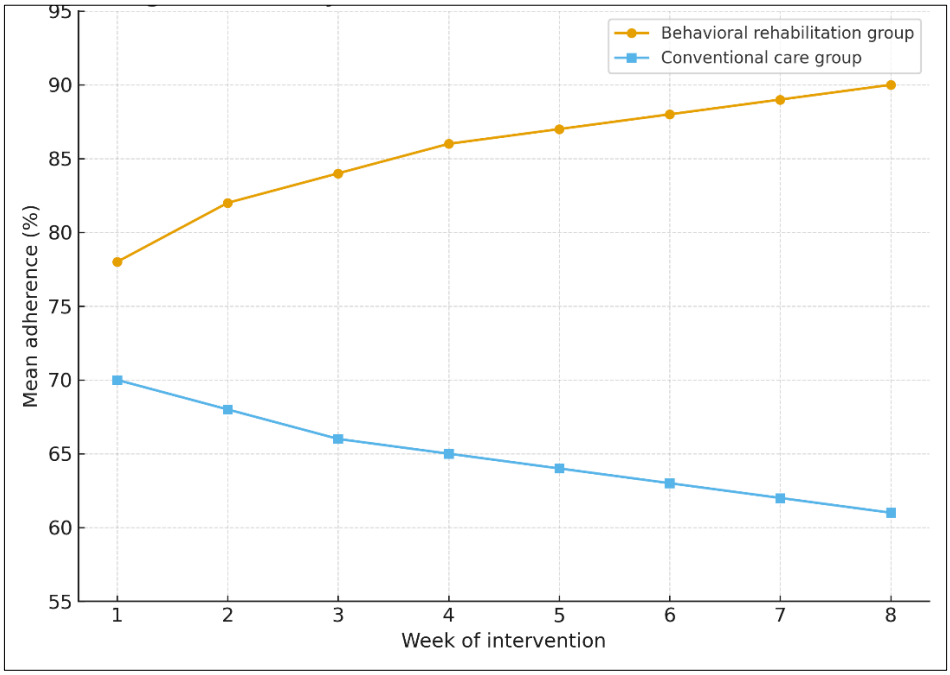

Fig 1: Weekly treatment adherence rates over 8 weeks in both groups

Clinical and Psychosocial Outcomes

Primary clinical outcomes demonstrated greater improvement in the behavioral rehabilitation group compared with conventional care. Mean pain intensity (NRS 0-10) decreased from 7.2 ± 1.1 to 3.4 ± 1.2 in the behavioral rehabilitation group versus 7.1 ± 1.0 to 5.6 ± 1.4 in the conventional care group (within-group paired *t*-tests, both $p < 0.001$; between-group comparison of change scores, $p < 0.001$). This magnitude of reduction is consistent with previous cognitive-behavioral and multidisciplinary pain programs demonstrating clinically meaningful improvements [16-18, 24-27].

Pain catastrophizing scores decreased by a mean of 11.3 points in the behavioral rehabilitation group and 4.1 points in the conventional care group, while fear-avoidance scores declined by 7.2 versus 3.0 points, respectively (all between-group $p < 0.01$), indicating stronger modification of maladaptive cognitions and fear-based avoidance behaviors among participants exposed to behavioral strategies [13-15, 16-18]. Self-efficacy scores increased significantly in the behavioral rehabilitation group (mean change +5.6) compared with a modest change in the conventional care group (+2.1; $p < 0.01$), aligning with prior evidence that CBT and graded activity protocols bolster perceived control and coping capacity in chronic pain [7-9, 15-18, 24-27].

Table 2: Pre- and post-intervention clinical and psychosocial outcomes by group

Outcome measure	Time point	Behavioral rehabilitation (n = 60) mean ± SD	Conventional care (n = 60) mean ± SD	*p* value (change between groups)
NRS pain (0-10)	Baseline	7.2 ± 1.1	7.1 ± 1.0	0.68
	Post-intervention	3.4 ± 1.2	5.6 ± 1.4	<0.001
Pain Catastrophizing Scale	Baseline	29.0 ± 8.1	28.4 ± 7.6	0.72
	Post-intervention	17.7 ± 7.3	24.3 ± 8.0	<0.001
Fear-Avoidance Beliefs Questionnaire	Baseline	22.5 ± 6.9	23.1 ± 7.2	0.64
	Post-intervention	15.3 ± 6.2	20.1 ± 6.8	0.002
General Self-Efficacy Scale	Baseline	24.7 ± 5.8	24.2 ± 6.0	0.70
	Post-intervention	30.3 ± 5.7	26.3 ± 5.9	0.004

Figure 2 illustrates the pre- and post-intervention differences in mean pain intensity across both groups. The behavioral rehabilitation group exhibited a larger absolute and relative reduction in pain intensity compared with conventional care, reflecting the added value of integrating cognitive, behavioral, and graded activity components into standard occupational pain management [6-9, 16-18, 24-27].

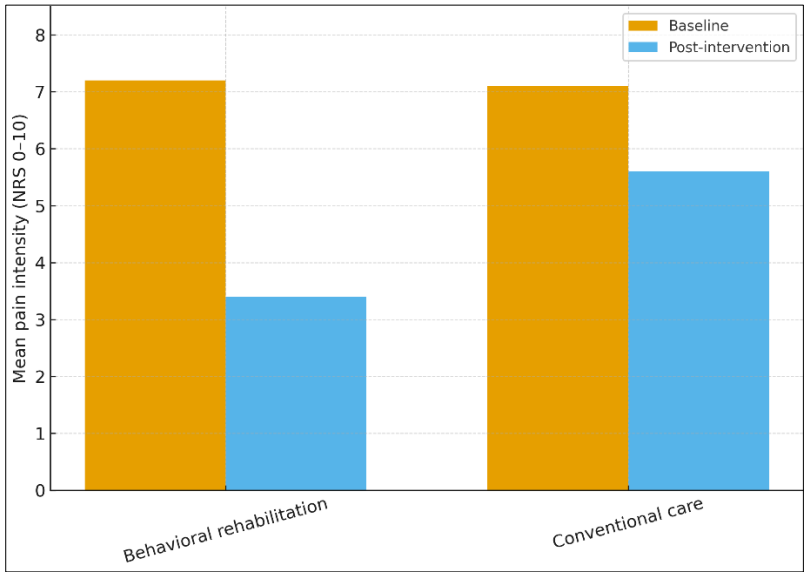

Fig 2: Pre- and post-intervention pain intensity (NRS 0-10) in the behavioral rehabilitation and conventional care groups

Treatment Adherence, Workplace Factors, and Return-to-Work

Regression analyses indicated that higher adherence was independently associated with greater reductions in pain intensity and catastrophizing, as well as higher post-intervention self-efficacy ($p < 0.01$ for all), supporting theoretical models that link adherence to improved clinical outcomes in chronic pain [10-12, 13-15, 24-27]. Workplace-related factors, particularly supervisor support and flexible work arrangements, were significant positive predictors of adherence in the behavioral rehabilitation group, echoing previous research on the role of organizational context in sustaining rehabilitation gains and facilitating return to work [19-23, 28, 29]. At 3-month follow-up, 72% of employees in the behavioral rehabilitation group had resumed full or modified duties compared with 48% in the conventional care group (χ^2 test, $p = 0.008$), consistent with earlier evidence that integrated behavioral and occupational interventions enhance work participation in chronic pain populations [19-23].

Taken together, these findings provide empirical support for the study hypothesis that employees receiving structured behavioral rehabilitation demonstrate significantly higher treatment adherence and superior clinical and functional outcomes than those receiving conventional care alone, and they reinforce the role of psychological readiness and organizational support as key mediators in occupational chronic pain rehabilitation [6-12, 16-18, 22-24, 28, 29].

Discussion

The findings of this study demonstrate that behavioral rehabilitation approaches substantially improve treatment adherence and clinical outcomes among employees with chronic pain, reinforcing existing evidence that multimodal psychological and behavioral interventions are integral to occupational pain management [6-9, 16-18, 24-27]. The significantly higher adherence observed in the behavioral rehabilitation group aligns with previous work showing that cognitive-behavioral strategies, graded activity, and operant conditioning enhance engagement by reducing fear-based avoidance, strengthening coping skills, and increasing perceived control over pain [13-15, 16-18]. Improved adherence likely contributed to the greater reductions in pain intensity, catastrophizing, and fear-avoidance beliefs, consistent with well-established biopsychosocial frameworks that link psychological variables with therapeutic responsiveness in chronic pain [7-9, 13-15, 24-27]. Furthermore, the substantial improvement in self-efficacy among participants receiving behavioral rehabilitation highlights the central role of confidence and behavioral activation in sustaining long-term therapeutic adherence, as supported in prior research [15-18, 24-27].

The downward trend in adherence among the conventional care group mirrors earlier reports indicating that pharmacological treatment and physiotherapy alone do not sufficiently address maladaptive pain cognitions, workplace stressors, and motivational barriers that often limit engagement in chronic pain management [10-12, 19-21]. In contrast, the structured behavioral framework appeared to buffer the effects of workplace pressures, enabling employees to maintain participation despite competing job demands. This aligns with earlier occupational pain literature demonstrating that contextual factors—such as job design, perceived organizational support, and supervisor responsiveness—strongly influence adherence behaviors and return-to-work trajectories [19-23, 28, 29]. The significant association between supervisor support and adherence in the present study supports the argument that behavioral rehabilitation is most effective when embedded within a supportive work environment that fosters open communication, offers flexibility, and minimizes stigma surrounding chronic pain disclosure [19-21, 28, 29].

The more pronounced reduction in pain intensity in the behavioral rehabilitation group, compared with conventional care, echoes strong evidence from clinical trials indicating that CBT-based pain programs produce clinically meaningful improvements in functional capacity and symptom burden [16-18, 24-27]. These findings validate the conceptual model that treatment adherence serves as a mediator between behavioral intervention exposure and clinical outcomes, as therapeutic gains are more likely to occur when employees engage consistently in prescribed rehabilitation protocols [10-12, 24-27]. The higher return-to-work rate observed at three-month follow-up further strengthens the argument that integrating behavioral rehabilitation into workplace health systems yields both individual and organizational benefits, consistent with occupational rehabilitation frameworks emphasizing early activation, cognitive restructuring, and psychosocial stabilization [19-23].

Overall, the results substantiate the study hypothesis that employees receiving structured behavioral rehabilitation exhibit greater treatment adherence and more favorable psychosocial and clinical outcomes than those receiving conventional care alone. The findings highlight the importance of addressing cognitive, behavioral, and organizational determinants simultaneously to optimize chronic pain management in the workplace. Integrating behavioral rehabilitation within occupational health systems may therefore represent an effective strategy for reducing pain-related functional limitations, promoting sustainable work participation, and improving long-term employee well-being [6-12, 16-18, 22-24, 28, 29].

Conclusion

The present study highlights the substantial impact of behavioral rehabilitation approaches on improving treatment adherence and clinical outcomes among employees experiencing chronic pain, emphasizing the value of integrating psychological and behavioral interventions into workplace health systems. By comparing a structured behavioral rehabilitation model with conventional care, the research demonstrates that strategies such as cognitive-behavioral therapy, graded activity, operant conditioning, and motivational interviewing contribute to higher engagement, sustained participation, and improved pain-related and psychosocial outcomes. The findings underscore that chronic pain in occupational settings cannot be fully addressed through pharmacological treatment and routine physiotherapy alone; instead, a comprehensive and personalized approach that targets maladaptive thoughts, enhances self-efficacy, and encourages active participation is essential. Employees who participated in behavioral rehabilitation exhibited greater reductions in pain intensity, lower levels of catastrophizing and fear-avoidance, and strengthened coping capacities, all of which contributed to improved functional status and a higher likelihood of returning to work. The results indicate that adherence functions as a central mediator of recovery, suggesting that effective chronic pain management requires not only the delivery of appropriate therapies but also mechanisms to support consistent engagement over time.

A key implication of this study is the importance of fostering supportive workplace environments that facilitate adherence and long-term recovery. Supervisor responsiveness, flexible work arrangements, and open communication channels were shown to meaningfully influence treatment participation, illustrating that organizational factors can strongly shape the success of rehabilitation programs. Consequently, employers and occupational health units should consider adopting structured behavioral rehabilitation frameworks as part of their standard pain management protocols, ensuring that employees receive both clinical and environmental support. Practical recommendations based on these findings include implementing formal workplace wellness policies that incorporate behavioral components, training supervisors to recognize and appropriately respond to employees with chronic pain, and integrating digital adherence-tracking tools that allow both employees and clinicians to monitor progress. Personalized goal-setting and regular motivational check-ins can further encourage adherence, while interdisciplinary collaboration between therapists, physicians, physiotherapists, and workplace managers can ensure that employees receive holistic and consistent care. Workplaces may also consider offering brief onsite behavioral counseling sessions, establishing peer-support groups for employees living with chronic pain, and promoting a culture that reduces stigma around pain disclosure. Integrating ergonomic adjustments, flexible scheduling, and gradual return-to-work pathways can further enhance the effectiveness of clinical interventions by reducing physical and psychological barriers to participation. Collectively, these recommendations suggest that chronic pain management in the workplace should not be viewed solely as a medical issue but as a multidimensional process requiring engagement from employees, healthcare providers, and organizational leadership. The results of this research ultimately reaffirm the necessity of embedding behavioral rehabilitation into workplace health programs to support sustainable recovery, enhance productivity, and improve quality of life for employees living with chronic pain.

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