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Research letter

Multidisciplinary rehabilitation of the spine: a prospective comparison of an autonomy-based versus supervised rehabilitation model

Crombecque Steven^{a,b,c,*}, Caby Isabelle^a, Mrozek Aymeric^c, Deseur Marine^b, Ratajczak Isabelle^c, Legrand Jean-Louis^b, Toulotte Claire^d

^a Univ. Artois, Univ. Lille, Univ. Littoral Côte d'Opale, ULR 7369, Multidisciplinary Research Unit for Sport, Health and Society (URePSSS), Chemin du Marquage, 62800 Liévin, France

^b Hopale Foundation, 45 Rue du Dr Calot, 62600 Berck, France

^c Helene-Borel Center, 3 Avenue Du Château du Liez, 59283 Raimbeaucourt, France

^d Univ. Grenoble Alpes, CNRS, Grenoble INP, GIPSA-lab, 11 Rue des Mathématiques, 38000 Grenoble, France

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Dear Editor

Chronic Low Back Pain (CLBP) is one of the leading causes of disability worldwide and represents a major public health burden [1,2]. Clinical practice has progressively shifted from passive, biomedical care toward active, biopsychosocial rehabilitation in which physical activity and exercise therapy are central as they reduce pain and improve function [3]. Intensive multidisciplinary rehabilitation programs, historically termed “multidisciplinary rehabilitation,” are benchmark interventions and have achieved short-term gains and high return-to-work rates [4–7]. However, sustaining these benefits is challenging. Improvements in physical capacity, quality of life, and health behaviors often diminish within 6 months after program completion [8,9]. One hypothesis is that highly supervised models may foster dependency, whereas programs that cultivate participant autonomy and structured therapeutic education might equip participants to self-manage more effectively and preserve gains over time [10–12]. To our knowledge, no study has directly compared a rehabilitation model prioritizing autonomy to a supervision-heavy approach within a similar multidisciplinary framework.

We conducted a prospective, controlled study to evaluate whether an autonomy-enhanced, participatory multidisciplinary rehabilitation program would produce at least equivalent immediate outcomes and better medium-term retention of gains compared with a standard supervised program. Between September 2022 and September 2024,

122 individuals who met the inclusion criteria (CLBP >3 months, age 18–65, unresponsive to prior conservative care, medical clearance for intensive exercise) were screened across 2 rehabilitation centers in Northern France. Group allocation was determined by center; the study was not randomized. Participants were referred based on geographic proximity and pre-existing referral pathways. Referral pathways and participant characteristics at the 2 sites were comparable, and no center-specific referral patterns suggested systematic differences in case severity.

Of 122 participants, 97 were included in final analyses (P1 = 60; P2 = 37). Attrition consisted of 23 program dropouts. Two additional participants were excluded due to >10% missing data, a threshold recommended to minimize bias [13]. Within the analyzed sample, 18 participants had sporadic missing outcomes; 83 values (0.21% of all data points) were imputed using multiple imputation by chained equations (MICE; $m = 5$). Dropout rates did not differ between groups (P1: 19% vs P2: 24%; $P = 0.52$).

Both rehabilitation centers delivered a 117-h multidisciplinary program over 4 weeks using identical exercise modalities, such as resistance training, cardiovascular ergometry, stretching, and hydrotherapy, yet they employed fundamentally different implementation strategies. The first center implemented a participatory, autonomy-focused model (Group P1, $n = 60$) that dedicated over 30% of therapy time to self-directed practice and featured a robust educational curriculum

Abbreviations: CLBP, Chronic Low Back Pain; DALLAS, Dallas Pain Questionnaire; EIFEL, Echelle d'Incapacité Fonctionnelle pour l'Évaluation des Lombalgies (French Roland-Morris Disability Questionnaire); FABQ, Fear-Avoidance Beliefs Questionnaire; FABQ-PA, Fear-Avoidance Beliefs Questionnaire – Physical Activity subscale; FABQ-Work, Fear-Avoidance Beliefs Questionnaire – Work subscale; GHQ-12, General Health Questionnaire (12 items); MCID, Minimal Clinically Important Difference; MICE, Multiple Imputation by Chained Equations; ONAPS, Observatoire National de l'Activité Physique et de la Sédentarité (French Physical Activity Questionnaire); VAS, Visual Analogue Scale

*Corresponding author.

E-mail address: Stevencrombecque@univ-artois.fr (C. Steven).

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comprising 4 weekly sessions on pain neurophysiology, coping strategies, and post-program planning. In this model, strength and endurance exercises were performed independently with mid-program intensity adjustments, eventually transitioning to home-based stability routines by the 3rd week. Conversely, the second center used a predominantly supervised model (Group P2, $n = 37$) in which patients had only 3% independent time and followed a strictly progressive intensity protocol, such as a 5% weekly increase in heart rate zones and endurance times. While P2 included informal clinical exchanges, its structured education was limited to a single session on medication management, marking a sharp contrast to the systematic, autonomy-driven educational framework of the P1 group.

Outcomes were assessed at baseline (T1), program completion (T2, 4 weeks after T1), 4 months post-discharge (T3), and 6 months post-discharge (T4). Pain intensity (VAS) and functional disability (EIFEL) were designated as primary outcomes [14]. Secondary outcomes included physical performance (strength, endurance, flexibility), impact of pain on quality of life (DALLAS) [15], psychological distress (GHQ-12) [16], fear-avoidance beliefs (FABQ) [17], and physical activity levels (ONAPS). All physical performance tests followed standardized protocols commonly used in spine rehabilitation research (see Supplementary Material for detailed measurement procedures); lateral trunk endurance was assessed using the McGill side-bridge test, a validated and widely reported measure. Baseline demographic, socio-professional, and clinical characteristics were comparable across groups (Table 1). However, several physical performance measures differed at baseline, generally favoring group P2. Interpretation focused primarily on predefined primary outcomes (pain and disability), while secondary outcomes were considered exploratory.

Mixed-model repeated-measures ANOVA tested time (within-subject), group (between-subject), and time \times group interaction effects with $\alpha = 0.05$. Assumptions were systematically assessed, with appropriate corrections applied when necessary. Multiple imputation ($m = 5$) was performed using a model including all outcomes and baseline covariates. Post-hoc comparisons were adjusted using Holm–Bonferroni correction. With $n = 60$ vs $n = 37$, the study had 67% power to detect medium effects (Cohen's $d = 0.5$) and >95% power to detect large effects ($d = 0.8$). To limit the risk of alpha inflation related to multiple testing, pain intensity and disability were defined a priori as primary outcomes, while all other measures were considered secondary and interpreted exploratorily. Given the exploratory nature of this prospective study and the constraints of a research letter format, no a priori power calculation was performed. However, the sample size was comparable to that of previous studies in multidisciplinary spine rehabilitation and sufficient to detect clinically meaningful changes in the predefined primary outcomes.

Key outcomes are summarized in Tables 1–3. At discharge, both programs showed significant clinical improvement. Pain intensity decreased by approximately 2 VAS points in each group (exceeding the established MCID of 2 points [18]), with no between-group difference. Functional disability improved in both groups (P1: -3.6 points; P2: -5.8 points on EIFEL). P2's improvement exceeded the MCID threshold of 5 points [18], while P1's improvement, though statistically significant, fell slightly below this threshold. Psychosocial health also improved in both groups.

Significant time \times group interactions were observed on physical performance measures (Table 2). During the program (T1–T2), interactions favored P1 on trunk mobility (lateral tilt, rotations) and Sorensen endurance, while P2 showed greater improvement on Killy endurance, left lateral core strength assessed using the McGill side-bridge test protocol, and isokinetic extension. This mixed pattern, with neither approach consistently outperforming the other, suggests that program characteristics may differentially affect specific physical capacities. Given significant baseline differences on most physical measures (eg, Sorensen: P1 = 36.1 (28.7) sec vs P2 = 91.3 (32.2) sec), interpretation of between-group comparisons requires caution. The decline in Sorensen

endurance observed in P2 during follow-up, despite initially higher values, may reflect a greater reliance on external supervision for maintaining exercise intensity. In contrast, P1 participants, who had practiced self-directed exercise with recalibrated intensity throughout the program, may have been better equipped to sustain training independently after discharge. For patient-reported outcomes (Table 3), both groups improved significantly over time, with no significant time \times group interaction.

During follow-up, both models generally sustained their discharge gains. Within-group analyses showed no significant regression in physical performance over 6 months. From discharge to 4 months (T2–T3), significant time \times group interactions favored P1 on Sorensen, Killy, left hamstrings flexibility, and isokinetic trunk extension (Table 2). At 6 months, interactions persisted on Sorensen and Killy, with extension favoring P1, while P2 showed greater improvement on finger-to-floor distance. Interpretation of all between-group comparisons requires caution, given baseline disparities. For Sorensen endurance, the significant time \times group interaction largely reflects divergent baseline values (P1: 36.1 (28.7) sec vs P2: 91.3 (32.2) sec), with both groups reaching comparable levels at T3 (P1: 87.5 sec vs P2: 86.9 sec) and T4 (P1: 87.1 sec vs P2: 94.6 sec), suggesting convergence rather than true differential treatment effects.

Regarding patient-reported outcomes, within-group analyses showed continued improvements in P1 for fear-avoidance beliefs (FABQ-PA: T2–T4; $P = 0.04$) while P2 showed no significant change during follow-up; however, no significant time \times group interactions were observed (Table 3). At T2, the proportion of participants exceeding established clinical cut-offs did not differ between groups: FABQ-PA ≥ 14 (P1: 15.0% vs P2: 18.9%; $P = 0.823$) and FABQ-Work ≥ 29 (P1: 33.3% vs P2: 35.1%; $P = 1.000$). At T4, a trend favoring P1 was observed for FABQ-PA (P1: 11.7% vs P2: 29.7%; $P = 0.051$) [19,20]. A transient increase in psychological distress was observed in P1 at 4 months (GHQ-12: T2–T3; $P < 0.001$), which partially attenuated by 6 months (T2–T4; $P = 0.009$). Pain levels remained moderately improved in both groups through 6 months, without between-group differences. Importantly, neither program produced significant changes in free-living physical activity or sedentary time (ONAPS), underscoring the difficulty of translating clinic-based improvements into sustained lifestyle change [8,9,21,22].

The findings indicate that incorporating substantial autonomy and structured education into an intensive rehabilitation program does not compromise clinical benefit. The primary outcomes, pain and disability, improved equivalently in both programs despite markedly different supervision intensities (34 h vs 3 h of self-directed time). This equivalence on the most clinically relevant measures, combined with the absence of adverse effects in the autonomy group, provides preliminary evidence that intensive direct supervision may not be a prerequisite for successful multidisciplinary rehabilitation.

The observation that less formal supervision coincided with comparable or greater objective physical gains, particularly on trunk mobility measures, where baseline values were similar, can be interpreted through self-regulation and motivation mechanisms. Autonomy may give participants latitude to modulate effort and rest, helping them avoid “boom-and-bust” cycles in which overexertion triggers flares followed by inactivity. In self-determination theory, autonomy is a core driver of intrinsic motivation; when participants have meaningful choice and control, they may engage more deeply and sustain effort more effectively [10,11].

Both programs yielded comparable improvements in self-reported function and mental well-being at discharge, with no significant between-group differences. P1's sessions on pain neurophysiology, healthy movement, and coping strategies were designed to correct unhelpful beliefs and provide concrete self-management tools. These sessions addressed pain mechanisms, pacing strategies, and graded exposure to movement, with the aim of supporting self-management beyond supervised sessions. The sustained within-group improvements in P1's fear-related beliefs (FABQ-PA: significant improvement

Table 1
Baseline characteristics of participants.

Variable	P1 (n = 60) ^{a,b}	P2 (n = 37) ^c	P-value ^d
Demographics			
Age (years)	44.5 (11.7)	40.5 (8.9)	0.089
Male, n (%)	28 (46.7%)	16 (43.2%)	0.905
BMI (kg/m ²)	28.1 (4.8)	27.0 (4.3)	0.223
Socio-professional status, n (%)			
Active employment	16 (26.7%)	12 (32.4%)	0.778
Sick leave/Work injury	28 (46.7%)	17 (45.9%)	
Unemployed/Retired/Student	16 (26.7%)	8 (21.6%)	
Clinical			
LBP duration (months)	10.4 (8.6)	8.7 (6.9)	0.336
Pain VAS (0–10)	5.8 (1.8)	6.1 (2.2)	0.221
Questionnaires			
EIFEL (0–24)	10.6 (5.1)	11.9 (4.6)	0.210
DALLAS - Daily activities (%)	61.2 (15.8)	58.8 (13)	0.064
DALLAS - Professional/Leisure (%)	63.2 (21.3)	58.7 (18.4)	0.052
DALLAS - Anxiety/Depression (%)	43.6 (25.7)	41.8 (26.9)	0.794
DALLAS - Sociability (%)	38.7 (22.3)	35.1 (19.9)	0.484
FABQ-PA (0–24)	12.0 (7.1)	10.9 (6)	0.405
FABQ-Work (0–42)	26.2 (13.7)	18.4 (12.4)	0.005
GHQ-12 (0–36)	26.9 (6)	30.1 (7.2)	0.047
Physical activity			
ONAPS Total (min/wk)	3638.7 (6283.2)	4261.2 (5684.4)	0.044
ONAPS Sedentary (min/d)	360.4 (248.5)	405.1 (191.8)	0.057
Trunk muscular endurance			
Sorensen (sec)	36.1 (28.7)	91.3 (32.2)	<0.001
Ito-Shirado (sec)	57.0 (37.7)	65.6 (34.3)	0.044
Right lateral core (sec) ^e	29.9 (20.3)	47.6 (17)	<0.001
Left lateral core (sec)	33.7 (22.6)	50.5 (19.5)	<0.001
Killy (sec)	44.0 (29.9)	67.5 (29.9)	<0.001
Trunk, pelvic and subpelvic mobility			
Finger-to-floor distance (cm)	12.9 (13.8)	8.7 (10.7)	0.038
Right lateral tilt (cm)	12.2 (4.1)	13.1 (4.5)	0.473
Left lateral tilt (cm)	15.7 (4.7)	15.3 (4.8)	0.639
Right trunk rotation (°)	73.0 (13.8)	77.2 (5.8)	0.089
Left trunk rotation (°)	71.7 (14.4)	77.4 (5.8)	0.049
Right hamstrings (°)	68.8 (14.3)	71.5 (15)	0.791
Left hamstrings (°)	69.7 (15.1)	71.6 (18)	0.832
Isokinetic muscle strength			
Extension (Nm/kg)	2.3 (1)	2.21 (0.8)	0.872
Flexion (Nm/kg)	1.89 (0.6)	1.78 (0.7)	0.345

Abbreviations: VAS, Visual Analogue Scale; EIFEL, French Roland-Morris Disability Questionnaire; DALLAS, Dallas Pain Questionnaire; FABQ-PA/-Work, Fear-Avoidance Beliefs Questionnaire - Physical Activity/Work subscales; GHQ-12, General Health Questionnaire; ONAPS, French Physical Activity Questionnaire.

^a Values are mean (SD) or n (%).

^b P1, autonomy-based program (n = 60).

^c P2, supervised program (n = 37).

^d Bold P-values indicate statistical significance (P < 0.05).

^e Lateral core strength measured using McGill side-bridge test.

maintained from T2 to T4) and the maintenance of physical capacities during follow-up may be consistent with this educational approach. The absence of significant change in some functional and participation-related subdomains (eg, EIFEL professional/leisure activities, Dallas subscales) despite education may reflect the multifactorial nature of these constructs, which depend not only on knowledge and beliefs but also on workplace constraints, social context, and external demands that are not directly modifiable within a short rehabilitation program. This participatory orientation is consistent with patient-as-partner frameworks, which emphasize shared responsibility and active engagement in rehabilitation. Together, these findings suggest that supervision intensity and autonomy may contribute differently to short-term reassurance and longer-term maintenance of gains.

The structured education component in P1 (four 60-min sessions, totaling 4 h) qualifies as an intensive educational intervention according to the classification proposed by Engers et al. [23], who demonstrated that oral education exceeding 2.5 h is significantly more effective for return to work and pain management than brief interventions. This dosage is also consistent with the recommendations of Dupeyron et al. [24],

who emphasized that structured education sessions, typically 4 to 8, are an essential component of multidisciplinary rehabilitation programs for chronic low back pain. However, direct comparisons of educational duration across studies remain limited by heterogeneity in content, delivery format, and classification of “education” vs informal therapeutic communication.

The absence of change in physical activity and sedentary behavior levels highlights the intention-action gap frequently observed in chronic pain rehabilitation [21]. Education alone may be insufficient to modify habitual physical activity in daily life without additional behavioral or environmental interventions. We also note that the ONAPS questionnaire was not administered at the end of the program. This naturally leads to a before-and-after comparison 3 months into the program, potentially negating any gains that may have materialized in the very short term.

Incorporating volitional training modules (eg, implementation intentions) may help translate clinical gains into sustained lifestyle changes [22]. From a healthcare organization’s perspective, therapist time can be reallocated toward education, pacing guidance, and autonomy

Table 2

Physical performance outcomes: descriptive statistics and statistical comparisons.

Variable	Descriptive data: Mean (SD)								Time effect (<i>P</i> -value)						Time × Group (<i>P</i>)		
	T1		T2		T3		T4		T1-T2		T2-T3		T2-T4		T1-T2	T2-T3	T2-T4
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2			
Trunk muscular endurance																	
Sorensen (<i>sec</i>)	36.1 (28.7)	91.3 (32.2)	63.7 (31.8)	104.6 (33.5)	87.5 (52.2)	86.9 (47.5)	87.1 (54.9)	94.6 (45.8)	0.002	0.017	NS	NS	NS	NS	<0.001 ^a	<0.001 ^a	0.03 ^a
Ito-Shirado (<i>sec</i>)	57 (37.7)	65.6 (34.3)	83.4 (40.8)	86.9 (42.8)	90.2 (65.2)	84.5 (58.6)	87.3 (67.2)	87.2 (61.1)	0.014	0.021	NS	NS	NS	NS	NS	NS	NS
Right lateral core (<i>sec</i>)	29.9 (20.3)	47.6 (17)	49.6 (27.6)	78.4 (31.6)	52.9 (33)	77.2 (32.8)	54.7 (33.9)	79.4 (25.9)	<0.001	<0.001	NS	NS	NS	NS	NS	NS	NS
Left lateral core (<i>sec</i>)	33.7 (22.6)	50.5 (19.5)	50.3 (25.6)	86.4 (31.1)	51 (39)	79.5 (34)	55.4 (39.8)	86.5 (27.4)	0.004	<0.001	NS	NS	NS	NS	0.03 ^b	NS	NS
Killy (<i>sec</i>)	44 (29.9)	67.5 (29.9)	59.6 (30.6)	121.2 (45.4)	81.5 (55.1)	118.5 (47.7)	68 (47.8)	115.2 (52.1)	0.004	<0.001	0.011	NS	NS	NS	0.003 ^b	0.03 ^a	0.03 ^a
Trunk, pelvic, and subpelvic mobility																	
Finger-to-floor (cm)	12.9 (13.8)	8.7 (10.7)	4.7 (11.4)	-1.9 (8.5)	4.7 (14.4)	-1.2 (13.4)	6.9 (14.5)	-1.1 (16.1)	0.001	<0.001	NS	NS	NS	NS	NS	NS	0.006 ^b
Right lateral tilt (cm)	12.2 (4.1)	13.1 (4.5)	15.2 (4.2)	16.2 (4.6)	15.4 (4.2)	16.8 (4.8)	15.3 (4.1)	17.1 (4.6)	0.001	0.014	NS	NS	NS	NS	<0.001 ^a	NS	NS
Left lateral tilt (cm)	15.7 (4.7)	15.3 (4.8)		16.4 (4.7)	17.9 (4.7)	16.2 (4.9)	18.2 (4.9)	15.8 (4.7)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Right trunk rotation (°)	73 (13.8)	77.2 (5.8)	80.7 (15.1)	81.4 (5.4)	80.6 (14.3)	81.6 (5.5)	81 (14.2)	81.8 (5.3)	0.007	0.015	NS	NS	NS	NS	<0.001 ^a	NS	NS
Left trunk rotation (°)	71.7 (14.4)	77.4 (5.8)	79.2 (14.3)	81.7 (6.3)	79.2 (14.1)	81.4 (6.5)	78.9 (13.8)	81.4 (6.6)	0.002	0.024	NS	NS	NS	NS	<0.001 ^a	NS	NS
Right hamstrings (°)	68.8 (14.3)	71.5 (15)	79.5 (13.3)	80.3 (9.6)	73.7 (19.6)	77.6 (21.5)	74.6 (19.6)	77.3 (18.5)	<0.001	0.013	NS	NS	NS	NS	NS	NS	NS
Left hamstrings (°)	69.7 (15.1)	71.6 (18)	79.9 (14.2)	79.2 (10.8)	75.7 (19.8)	74.9 (15.9)	72.6 (19.6)	76.2 (12.4)	0.002	0.007	NS	NS	NS	NS	NS	0.013 ^a	NS
Isokinetic muscle strength																	
Extension (Nm/kg)	2.3 (1)	2.21 (0.8)	2.44 (1)	2.82 (0.8)	2.53 (1)	2.73 (0.7)	2.65 (1)	2.82 (0.7)	NS	0.02	NS	NS	NS	NS	<0.001 ^b	0.012 ^a	0.04 ^a
Flexion (Nm/kg)	1.89 (0.6)	1.78 (0.7)	2 (0.6)	1.97 (0.6)	1.86 (0.6)	1.91 (0.5)	1.88 (0.5)	1.74 (0.3)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Values are mean (SD). T1: baseline; T2: program discharge (4 weeks); T3: 4 months post-discharge; T4: 6 months post-discharge. P1: autonomy-based program ($n = 60$); P2: supervised program ($n = 37$). Time effect *P*-values from paired comparisons within each group. Time × Group interaction.

^aP1 showed greater improvement.

^bP2 showed greater improvement.

NS: not significant. Lateral core strength measured using the McGill side-bridge test.

Table 3
Self-reported outcomes: descriptive statistics and statistical comparisons.

Variable	Descriptive data: Mean (SD) ^a								Time effect (P-value)						Time × Group (P) ^b		
	T1		T2		T3		T4		T1-T2		T2-T3		T2-T4		T1-T2	T2-T3	T2-T4
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2			
Pain																	
VAS (0–10)	5.8 (1.8)	6.1 (2.2)	3.7 (1.9)	3.7 (1.7)	3.8 (2)	3.4 (2.2)	3.8 (2.1)	3.3 (2.3)	<0.001	<0.001	NS	NS	NS	NS	NS	NS	NS
Functional capacity																	
EIFEL (0–24)	10.6 (5.1)	11.9 (4.6)	7 (5.3)	6.1 (4)	5.6 (5.2)	6 (5.1)	6.7 (5.4)	4.8 (4.7)	<0.001	<0.001	0.01	NS	NS	NS	NS	NS	NS
Psychological state																	
GHQ-12 (0–36)	26.9 (6)	30.1 (7.2)	21.1 (5.6)	20.5 (5)	25.5 (8)	23.2 (7.9)	22.6 (7)	26.5 (7.9)	<0.001	<0.001	<0.001	NS	0.009	0.01	NS	NS	NS
DALLAS																	
Daily activities (%)	61.2 (15.8)	58.8 (17)	46.2 (19.4)	39.4 (20.2)	44.1 (22)	39.4 (22.2)	37.6 (28.9)	45.8 (21.4)	<0.001	<0.001	NS	NS	0.03	0.04	NS	NS	NS
Professional/Leisure (%)	63.2 (21.3)	58.7 (20.4)	46.7 (24.8)	36.8 (20.8)	43.5 (26.9)	37.3 (23.7)	39.6 (31.7)	33.4 (23.9)	<0.001	<0.001	NS	NS	NS	NS	NS	NS	NS
Anxiety/Depression (%)	43.6 (25.7)	41.8 (26.9)	29.9 (22.1)	27 (21.6)	34.3 (27.4)	26.6 (26.3)	28.6 (27.3)	26.9 (25.3)	<0.001	<0.001	NS	NS	NS	NS	NS	NS	NS
Sociability (%)	38.7 (22.3)	35.1 (19.9)	29 (20.5)	24.5 (19.5)	26.3 (24.9)	19.7 (20.4)	33.8 (29.1)	19.7 (20)	<0.001	<0.001	NS	NS	NS	NS	NS	NS	NS
Beliefs and fears																	
FABQ-PA (0–24)	12 (7.1)	10.9 (6)	7 (6.1)	7.2 (5.9)	7.7 (7.2)	9.4 (7.8)	5.7 (7.5)	8.4 (7.6)	<0.001	<0.001	NS	NS	0.04	NS	NS	NS	NS
FABQ-work (0–42)	26.2 (13.7)	18.4 (12.4)	20.8 (14)	18.3 (13.2)	18.5 (14.3)	18.1 (14.4)	22.1 (16.9)	18.6 (13.1)	<0.001	NS	NS	NS	NS	NS	NS	NS	NS
Physical activity																	
T1-T3	T1-T4																
ONAPS-total (min/wk)	3638.7 (6283)	4261.2 (5684)	—	—	4420 (5951)	4760 (5700)	3981 (6050)	4990 (5800)	x	x	NS	NS	NS	NS	NS	NS	NS
ONAPS-sedentary (min/d)	360.4 (248.5)	405.1 (191.8)	—	—	410 (235)	336 (195)	375 (245)	370 (210)	x	x	NS	NS	NS	NS	NS	NS	NS

Abbreviations: VAS, Visual Analogue Scale; EIFEL, French Roland-Morris Disability Questionnaire; DALLAS, Dallas Pain Questionnaire; FABQ-PA/Work, Fear-Avoidance Beliefs Questionnaire - Physical Activity/Work sub-scales; GHQ-12, General Health Questionnaire; ONAPS, French Physical Activity Questionnaire, T1, baseline; T2, program discharge (4 weeks); T3, 4 months post-discharge; T4, 6 months post-discharge. P1, autonomy-based program ($n = 60$); P2, supervised program ($n = 37$). Time effect P -values from paired comparisons within each group. NS = not significant; x = assessment not performed; — = data not collected at this time-point.

^a Values are mean (SD).

^b No significant Time × Group interactions were observed for self-reported outcomes (all $P > 0.05$).

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support without compromising clinical effectiveness. Such reallocation could improve program efficiency and potentially increase participant throughput, relevant for centers facing resource constraints. However, participants with severe deconditioning, high fear-avoidance, or complex psychosocial barriers may benefit from closer initial supervision. This finding aligns with emerging literature suggesting that participant engagement and self-regulation skills may be more important determinants of rehabilitation success than supervision intensity per se [10,11].

This study has limitations. Group allocation was center-based and non-randomized, introducing potential selection bias and site-specific effects. Several physical performance measures differed at baseline between groups (eg, Sorensen: $P1 = 36.1$ (28.7) *sec* vs $P2 = 91.3$ (32.2) *sec*; $P < 0.001$), likely reflecting organizational differences in assessment protocols rather than participant characteristics. These baseline disparities limit interpretation of time \times group interactions on physical measures, as differential improvement may partly reflect regression toward the mean or ceiling effects rather than true treatment differences. Trunk rotation measurements included both thoracic and shoulder girdle motion, potentially overestimating isolated thoracic axial rotation. Additionally, starting values near 71 – 77° suggest proximity to the physiological ceiling, which may attenuate between-group differences and limit the detection of meaningful change. Reliability data (eg, intra- and inter-rater agreement) were not formally assessed for the physical performance measurements used in this study. Trunk rotation was measured using the graduated scale of an oblique machine, and measurement precision depends on the device's accuracy. This may introduce unquantified measurement error into between-group comparisons. Furthermore, physical performance tests (lateral trunk tilt and rotation) were performed using manual tools. Although we followed a standardized protocol, these measures are subject to inherent measurement error; specifically, the absolute precision of the lateral tilt (eg, within 9 mm) and the inter-rater reliability were not formally tested in this study. However, within-group improvements were clinically meaningful in both programs. Blinding was not feasible, informal educational exchanges cannot be excluded, and return-to-work outcomes were not systematically collected. Social outcomes beyond return-to-work were not analyzed, as the primary objective was to evaluate program effectiveness based on physical condition and patient-reported perceptions of pain-related impact on quality of life. Although the inclusion of additional social measures would have been relevant and feasible, these outcomes were beyond the predefined scope of the study and should be explored in future research.

In conclusion, this prospective study suggests that integrating greater participant autonomy and targeted education into a multidisciplinary program for chronic low back pain may produce results comparable to those of a fully supervised model, although between-group comparisons should be interpreted with caution given baseline disparities, ceiling effects on certain physical measures, and unquantified measurement error. Within-group analyses suggested better maintenance of improvements in fear-avoidance beliefs (FABQ-PA) in the autonomy group during follow-up. Both approaches achieved clinically meaningful improvements in pain and disability. Empowering participants by involving them in the planning and pacing of exercises did not compromise short-term effectiveness. These results support autonomy-based rehabilitation as a viable alternative to fully supervised approaches, particularly when resources are constrained, while acknowledging that individual needs should guide program selection.

Declaration of generative AI and AI-assisted technologies in the writing process

No artificial intelligence tools were used in writing or editing this manuscript.

Ethics approval

This study was approved by the Non-Interventional Research Ethics Committee, University of Picardy Jules Verne (2025-01-7/2025-51).

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Data availability

The data that has been used is confidential.

Declaration of competing interest

None.

Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.rehab.2026.102127](https://doi.org/10.1016/j.rehab.2026.102127).

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