BMC Musculoskeletal Disorders

RESEARCH

Open Access

Motivation to exercise in patients with chronic low back pain

Marketa Nevelikova[1,2], Filip Zlamal[3], Filip Dosbaba[2,4,5], Jing Jing Su[6*] and Ladislav Batalik[2,4,5,7*]

Abstract

Background Chronic low back pain (CLBP) is one of the most common musculoskeletal problems worldwide. Even though regular exercise is recommended as the primary conservative approach in treating this condition, significant part of patients lead sedentary lifestyle. Motivation to exercise is one of the variables that effects the adherence of exercise-based treatments. This study aimed to characterize the motives for exercise, as posited by self-determination theory, in persons with CLBP, and to identify subgroups (clusters) of motivational profiles in combination with socioeconomic and clinical characteristics using k-means cluster analysis.

Methods Data were collected between September 2022 and September 2023. A total of 103 adults with CLBP completed the paper-pencil Exercise Self-Regulation Questionnaire (SRQ-E) and provided self-reported measures on anthropometric and socio-economic characteristics. Inclusion criteria were age (≥ 18 years) and non-specific CLBP (lasting longer than 12 weeks). Exclusion criteria included specific lumbar spine pathology (e.g., fracture, cancer), worsening neurological symptoms, recent injection therapy (within 3 months), and current alcohol or drug misuse.

Results Three distinct motivational clusters were identified among the 103 participants: two clusters were characterized by predominantly autonomous motivation (moderately motivated cluster: 31.1%; highly motivated cluster: 54.4%), while one cluster (controlled convinced cluster: 14.6%) showed a higher level of controlled motivation. Associations were observed between the controlled cluster and factors such as higher disability scores, longer duration of pain, greater number of completed physiotherapy sessions, and elevated BMI. Notably, the controlled motivation cluster was linked with poorer clinical outcomes.

Conclusions This study provides insights into the exercise motivation of patients with CLBP, revealing that while most patients were primarily autonomously motivated, a notable subgroup exhibited lower, controlled motivation. The presence of controlled motivation was associated with worse functioning, longer pain duration, and increased utilization of physiotherapy services. Although these findings suggest a link between motivational profiles and clinical outcomes, the cross-sectional design limits causal inferences. Further research is needed to explore these relationships longitudinally.

Trial registration ClinicalTrials.Gov Identifier: NCT05512338 (22.8.2022, NCT05512338).

Keywords Chronic low back pain, Exercise motivation, Self-determination theory, Physiotherapy adherence

*Correspondence:
Jing Jing Su
sujj@link.cuhk.edu.hk
Ladislav Batalik
batalik.ladislav@fnbrno.cz

Full list of author information is available at the end of the article

Background

Chronic low back pain (CLBP) is characterized by sensation of pain or discomfort situated in the lower back area, lasting for a minimum of 12 weeks or longer and may originate from various underlying causes, including musculoskeletal, neurological, or structural factors [1, 2, 3]. Compared with other chronic health conditions such as diabetes or chronic obstructive pulmonary disease, its occurrence is almost double [2]. Lower back pain is the leading cause to disability-adjusted life; and CLBP often affects individual's daily activities, functional capacity, and overall quality of life [2, 4].

When assessing a patient presenting with lower back symptoms, defining a specific cause may prove challenging, as CLBP, in contrast with acute LBP, stems from complex interplay of physiological, biomechanical, psychological, and social factors, making its diagnosis, management, and treatment challenging [5].

Based on current research, regular exercise is recommended as the primary conservative and cost-effective approach in treating CLBP, as it addresses not only underlying musculoskeletal imbalances and biomechanical dysfunctions [6, 7, 8, 9], but also leads to reduction in pain and pain sensitivity (exercise-induced hypoalgesia) [10, 11], effects conditioned pain modulation [12], although different types of exercise may have varying effects [13]. Exercise is also associated with a better mood and can influence depression and anxiety [14].

Despite extensive research in this area, we still do not know which type of therapeutic exercise is the most effective, nor do we know the optimal exercise settings—such as the number of sessions and intensity [15]. However, the largest network meta-analysis in the field of low back pain conducted by Hayden et al. [13] found, that most types of exercise in higher dose are more effective than minimal treatment - to increase the dosage, patients should engage in exercises they enjoy to promote adherence.

Nevertheless, exercise can act as a positive coping mechanism by enabling individuals to actively participate in their own recovery and gain confidence and autonomy which leads to sustained self-efficacy [9].

Despite the many benefits regular exercise offers, patients with CLBP often lead a sedentary lifestyle and their degree of compliance with treatment or exercise regimens is low [16, 17].

Nonetheless, the effectiveness of exercise-based approaches lies not only on the prescribed regimens but also in the motivation of CLBP patients to engage in regular physical activity. The motivation of CLBP patients is a complex interplay of intrinsic and extrinsic factors that significantly influence exercise participation, adherence, and ultimately, treatment outcomes [18, 19].

One of the most widely used theories for investigating motivation is self-determination theory (SDT) developed by Deci and Ryan [20]. It is a theoretical approach useful for understanding both the initiation of and adherence to exercise because it gives a perspective on both the quality of motivation and the conditions that determine its development [9]. SDT defines six forms of behavior regulation that can be described as a scale of increasingly internalized reasons for behavior – amotivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic regulation. For additional details on this topic, refer to studies by Deci and Ryan [20], Howard et al. [21], Chan et al. [22], Markland and Tobin [23].

Current research

Although there is a considerable number of studies examining motivation in various interest groups such as education [24], work [25] or sport performance [26], the field of rehabilitation has a rather limited number of them.

The majority of published studies focus on motivation as a positive mediator of adherence to regular physical activity. The authors agree that autonomous regulation style positively predicts adherence not only in patients with CLBP, but also in a range of other conditions such as rheumatoid arthritis [27] or in patients after anterior cruciate ligament reconstruction surgery [22].

The role of physiotherapists in promoting autonomous motivation in patients with CLBP is another area of interest in current research. Several authors conclude that integrating exercise with educational interventions and motivational strategies leads to greater improvements in disability and kinesiophobia [28], provides greater support for patients' psychological needs [29, 30]. Holden, Davidson and O'Halloran [31] reached similar conclusions and added that the biggest barrier for not providing motivational-oriented treatment is physiotherapists' lack of training and time.

Same conclusions can be found in studies focused on other chronic conditions. O´Riordan ´s et al. study [32] on chronic neck pain suggests that programs should be comprehensive, incorporating both active exercise and educational components.

When examining studies focused on exercise motivation in back pain patients, we can highlight the study conducted by Kleinert et al. [18], who were, to our knowledge, the first and only to assess exercise motivation in patients and non-patients with back pain. Their study also showed the importance of evaluating regulation style rather than individual motivational subscales. They identified 4 motivational profiles from a sample of 254 patients and non-patients, with half of them showing a negative motivation pattern (low values or controlled motivation) which supports the need for assessment,

training and further development of motivation-oriented training. Furthermore, they discovered relationships between motivational profiles and variables such as age, body concept and type of exercise or treatment.

Knowledge of the relationship between personal characteristics and motivational profiles has the potential to identify specific variables that may serve as yellow flags for maladaptive behavior and thus expedite the screening of patients suitable for motivation-oriented therapy.

Therefore, we can conclude that current research focused on motivation in patients with CLBP provides information on the impact of quality of motivation on adherence and therapy outcomes. Furthermore, it offers evidence of the significance of specific interventions aimed at facilitating autonomous motivation. Specific interventions should integrate physical and psychological treatments, i.e., motivational interviewing, physiotherapy informed by acceptance and commitment therapy etc.

However, to date, no research has been conducted that evaluates motivational profiles and their relationship to personal and other characteristics in such a prevalent diagnosis as CLBP; thus enabling an understanding of the need for specific interventions and the variables associated with a higher risk of maladaptive behavior in this patient population.

This is the first study based on self-determination theory that provides the understanding of exercise motivation in CLBP - related disability, and duration and evaluates the relationships between motivational profiles and patients´ personal characteristics.

Methods

Participants

Patients with CLBP under the care of a physician at Brno University Hospital between September 2022 and September 2023 were invited to participate in the study. Standard physiotherapy was prescribed for all patients as part of their comprehensive treatment plan. This physiotherapy included therapeutic exercise (Dynamic Neuromuscular Stabilization), soft tissue techniques, and electrotherapy (Gymna Combi 200, Limburg, Belgium) (see Supplementary Table) [33, 34]. After receiving detailed information about the study, 103 patients agreed to participate. All participants completed a paper-pencil questionnaire (see Supplementary File 1), which collected additional demographic information (age, level of education, financial distress). The final sample consisted of 103 participants.

Sample estimation

The sample size for this study was determined based on guidelines for cluster analysis, which suggest that at least 20–30 participants per expected subgroup are needed to achieve sufficient statistical power [35]. As we anticipated identifying three clusters, a target sample size of approximately 100 participants was considered appropriate. The final sample size of 103 participants was sufficient to ensure reliable cluster analysis and classification accuracy.

Inclusion and exclusion criteria

The criteria for inclusion were age (≥ 18 years old), non-specific CLBP (duration longer than 12 weeks). Exclusion criteria included the presence of specific lumbar spine pathology (i.e., fracture, cancer), deteriorating neurological signs, injection therapy within 3 months and current alcohol or drug misuse. All patients who visited the Clinic of Rehabilitation Medicine at the University Hospital during the recruitment phase were screened by the admitting physician. This screening involved interview, collecting medical history, conducting a physical examination, and reviewing medical records to identify and exclude participants who did not meet the study requirements. Patients who met the criteria filled out a questionnaire on-site, which was then submitted to the physiotherapist for completeness check and subsequent evaluation.

Measures

Exercise motivation

The 16-item Exercise Self-Regulation Questionnaire (SRQ-E) developed by Brown, Miller and Lawendowski [36] was used to assess participants' motivation to exercise. SRQ-E is domain specific version of the main SRQ, which was validated in Czech language by Gavora, Jakesova and Kalenda [37]. Values range from 1 to 7, higher scores mean a better outcome. Responses are given on a seven-point Likert scale with increments ranging from 1 (not true at all) to 7 (very true).

This questionnaire is designed to investigate the underlying motivations for an individual's consistent engagement in exercise. Its structure is formulated to pose inquiries and solicit responses representative of external regulation, introjected regulation, identified regulation, and intrinsic motivation. The fundamental inquiry revolves around assessing the level of autonomy perceived by the individual concerning their involvement in exercise or physical activity.

In addition to computing individual subscale scores, we derived the Relative Autonomy Index (RAI), that concerns the degree to which one´s motivation is self-determined.To form the RAI, we used defined formula that combines the subscale scores. Amotivation subscale was excluded from the RAI calculation, given its focus on the assessment of non-motivation.

Functioning and disability

Patient functioning and disability was measured by the 24-item Roland-Morris Disability Questionnaire developed by Rolland and Morris [38]. It consists of 24 questions aimed at evaluating the patient's capacity to execute routine daily tasks that typically pose challenges for individuals experiencing CLBP. Values range from 0 to 24, lower scores mean a better outcome.

Duration of pain

The duration of lower back pain in years, months and weeks was assessed (self-reported) and categorized as chronic pain with duration of 12 weeks and longer.

Previously completed physiotherapy sessions

Number of previously completed physiotherapy sessions for non-specific CLBP were assessed.

Data and statistics

Our data comprise two types of variables. Continuous variables are characterized via mean and standard deviation whereas categorical variables are represented using absolute and relative frequencies of the groups. Relationship between categorical variables was evaluated by Pearson chi-squared and Fisher exact test (together with Cramer's V coefficient as effect size). To determine the relationship between continuous variables, correlation analysis using the Spearman rank correlation coefficient was used. Spearman's rank correlation coefficient was used instead of Pearson's coefficient because the distribution of the data did not follow two-dimensional normality (which is necessary condition for statistical tests about Pearson's coefficient). Spearman's coefficient is more robust than Pearson's coefficient. For the purpose of intergroup comparisons between continuous variables distributions, parametric tests (t-test, ANOVA, Welch ANOVA) as well as nonparametric statistical tests (Mann-Whitney, Kolmogorov-Smirnov, Kruskal-Wallis, Mood's median) were used. Appropriate effect sizes for these tests were also calculated. These effect size measures were used for each inferential test: t-test: Cohen's d – 0-0.2 negligable, 0.2–0.5 small, 0.5–0.8 moderate, > 0.8 large Mann-Whitney: coefficient r = Z/sqrt(n) – 0-0.1 negligable, 0.1–0.3 small, 0.3–0.5 moderate, > 0.5 large ANOVA: coefficient h 2–0-0.01 negligable, 0.01–0.06 small, 0.06–0.14 moderate, > 0.14 large Welch ANOVA: coefficient w 2 adj – 0-0.01 negligable, 0.01–0.06 small, 0.06–0.14 moderate, >0.14 large Kruskal-Wallis: coefficient h 2 =(H-k + 1)/(n-k) – 0-0.01 negligable, 0.01–0.06 small, 0.06–0.14 moderate, > 0.14 large. Mood's median: coefficient phi = sqrt (c 2 /n) – 0-0.1 negligable, 0.1–0.3 small, 0.3–0.5 moderate, > 0.5 large. In the case of parametric tests, normality was checked graphically (histogram, Q-Q plot) and by statistical tests (Shapiro-Wilk, Pearson chi-square, Anderson-Darling), and homoscedasticity by appropriate statistical tests (F-test, Bartlett, Levene). In the case of necessary use of p-values adjustment for multiple comparisons, Benjamini-Hochberg method was used. To identify potential clusters within group of subscales, the k-means clustering method was used. K-means clustering is method for partitioning dataset into k cluster (i.e. distinct and non-overlapping subsets). It is an algorithm of nonhierarchical clustering analysis. Number of clusters (k) need to be specified at the beginning. The objects are represented as points in multidimensional euclidean space.

Clusters are defined by their centroids – points in the same space as the data points. In the first step the centroid are set (given by user or randomly chosen). Then the object are iteratively attached to the closest clusters. In each iterative steps the positions of centroids are recalculated. At the end to the algorithm all subjects are classified into predetermined number clusters. For the purpose of statistical testing p-values less than 0.05 were considered statistically significant. All statistical analyses were performed using statistical software R, version 4.3.2.

Results

Characteristics of the sample

The sample (Table 1) consisted of 67 women (65%) and 36 men (35%) with a mean age of 55.77 (SD = 14.19). 25 participants (24.3%) had attained advanced educational qualifications (university level), 63 participants (61.2%) had intermediate educational qualifications (secondary level), and 15 participants (14.6%) had basic educational qualifications (primary level). Among all participants, 6 (6.8%) reported financial distress. The mean BMI of the sample is 28.67 (SD = 5.33).

Exercise motivation

Concerning the four subscales of motivation to exercise, participants on average showed low values in controlled forms of regulation. Most prevalent form of regulation was introjected behavioral regulation. Positive correlations exist among all subscales (Table 2). The four subscales are positively moderately intercorrelated (except for external-identified and external-intrinsic with no significant correlation). The remaining group of variables (age, RMQ) are also positively intercorrelated (with small to moderate strength), except for age-BMI (no significant correlation). Different RAI score distributions were found within the clusters ($\chi 2(2) = 50.698$, $p < 0.001$, $\eta 2 = 0.49$ - large effect size).

Clusters of exercise motivation

The k-means cluster analysis revealed solutions for thirteen, three, and two clusters (Table 3). The three-cluster model was chosen as the most appropriate for this

Table 1 Descriptive statistics of the sample

	sex		*p*-value	statistical test
	female (*n* = 67)	male (*n* = 36)		
External	1.8 ± 1.0	1.7 ± 1.2	0.343	MW
Introjected	3.7 ± 1.3	3.7 ± 1.5	0.977	t-test
Identified	6.0 ± 1.1	5.9 ± 1.0	0.239	MW
Intrinsic	5.0 ± 1.3	4.7 ± 1.1	0.169	KS
RAI	8.7 ± 4.2	8.1 ± 4.0	0.470	MW
Age	57.0 ± 13.1	53.4 ± 16.0	0.220	t-test
Duration of pain	9.9 ± 9.8	5.6 ± 6.5	0.018	MW
Previously completed physiotherapy sessions	6.6 ± 6.4	4.2 ± 4.9	0.022	MW
BMI	28.4 ± 5.7	29.1 ± 4.5	0.511	t-test
RMQ	8.6 ± 4.8	7.1 ± 3.9	0.158	MW
Education level				
Primary	8	7	0.402	Pearson
Secondary	44	19		
University	15	10		
Financial distress				
no	61	35	0.417	Fisher
yes	6	1		

t-test – Student's two sample t-test, MW – Mann-Whitney test, KS – Kolmogorov-Smirnov test

Table 2 Correlation matrix (Spearman rank correlation coefficient)

	external	introjected	identified	intrinsic	RAI	age	Duration of pain****	Completed PT session	BMI
introjected	**0.51*** **								
identified	0.02	**0.40*** **							
intrinsic	-0.04	**0.41*** **	**0.57*** **						
RAI	**-0.63*** **	-0.18	**0.50*** **	**0.68*** **					
age	0.15	0.07	-0.08	-0.05	**-0.25***				
Duration of pain	0.12	-0.05	-0.11	-0.08	-0.17	**0.47*** **			
Completed PT sessions	**0.20***	0.09	0.02	-0.10	**-0.26** **	**0.51*** **	**0.71*** **		
BMI	0.06	-0.07	-0.19	**-0.37*** **	**-0.27** **	0.06	**0.21***	**0.25***	
RMQ	**0.38*** **	0.15	0.06	-0.13	**-0.28** **	**0.21***	**0.35*** **	**0.40*** **	**0.22***

* $0.01 \leq p < 0.05$

** $0.001 \leq p < 0.01$

*** $p < 0.001$

**** in years

sample size. Quantitative fit was tested using ANOVA and Mood's median test, and discriminant analysis showed strong differences between clusters for all four regulation forms (external: $\omega = 0.76$, introjected: $\eta^2 = 0.45$, identified: $\omega = 0.85$, intrinsic: $\eta^2 = 0.49$). Discriminant analysis correctly classified 95% of the cases; however, this high accuracy may reflect the specific characteristics of our sample, and caution is warranted when interpreting these results, as overfitting may be a concern given the moderate sample size.

The three clusters are characterized as follows:

- Cluster 1 (n = 32, 31.1%): 'Moderately motivated' with low external and introjected regulation, moderate to high scores in autonomous regulation.
- Cluster 2 (n = 15, 14.6%): 'Controlled convinced' with high external and introjected scores, moderate to high autonomous scores.
- Cluster 3 (n = 56, 54.4%): 'Highly motivated' with highest scores in identified and intrinsic motivation, low to moderate controlled regulation scores.

Functioning and disability

Different score distributions were found within the clusters ($\chi 2(2) = 10.425$, $p = 0.005$, $\eta 2 = 0.08$ -moderate effect size). Participants belonging to cluster two 'controlled convinced' achieved the highest scores in RMQ (11.5 ± 4.9, $p = 0.005$), significantly different from cluster three 'highly motivated' followed (8.1 ± 4.6, $p = 0.005$) ($p = 0.027$) and one 'moderately motivated' (6.4 ± 3.6, $p = 0.005$) ($p = 0.005$). Clusters one 'moderately motivated'

Table 3 Identification of differences between clusters

	cluster			*p*-value	statistical test
	1	2	3		
External	$1.2 \pm 0.4^{a, b}$	$3.8 \pm 1.2^{a, c}$	$1.5 \pm 0.6^{b, c}$	< 0.001	Median
Introjected	$2.4 \pm 0.8^{a, b}$	4.7 ± 0.9^{a}	4.3 ± 1.1^{b}	< 0.001	ANOVA
Identified	5.2 ± 0.9^{a}	5.2 ± 1.2^{b}	$6.6 \pm 0.5^{a, b}$	< 0.001	Median
Intrinsic	3.8 ± 0.9^{a}	4.2 ± 1.0^{b}	$5.6 \pm 0.8^{a, b}$	< 0.001	ANOVA
RAI	$8.0 \pm 2.3^{a, b}$	$1.4 \pm 4.1^{a, c}$	$10.6 \pm 2.5^{b, c}$	< 0.001	KW
age	57.0 ± 14.7	61.8 ± 17.1	53.4 ± 12.7	0.105	ANOVA
Duration of pain	7.4 ± 7.9^{a}	$12.5 \pm 8.1^{a, b}$	7.9 ± 9.6^{b}	0.029	KW
Previously completed physiotherapy sessions	4.8 ± 4.2^{a}	$10.5 \pm 8.7^{a, b}$	5.0 ± 5.5^{b}	0.045	KW
BMI	29.4 ± 5.0	31.6 ± 5.9^{a}	27.5 ± 5.0^{a}	0.018	ANOVA
RMQ	6.4 ± 3.6^{a}	$11.5 \pm 4.9^{a, b}$	8.1 ± 4.6^{b}	0.005	KW
Sex					
female	18	10	39	0.443	Pearson
male	14	5	17		
Education level					
Primary	5	4	6	0.500	Pearson
Secondary	20	9	34		
University	7	2	16		
Financial distress					
no	29	14	53	0.862	Fisher
yes	3	1	3		

Groups with same superscript are statistically significantly different

Median - Mood's median test, KW - Kruskal- Wallis test, duration of pain – in years

and three 'highly motivated' are not significantly different ($p = 0.140$).

Duration of pain

Different score distributions were found within the clusters ($\chi2(2) = 7.099$, $p = 0.029$, $\eta2 = 0.05$ -small effect size). Participants belonging to cluster two 'controlled convinced' indicated that they have been treating CLBP pain the longest (12.5 ± 8.1, $p = 0.029$) significantly differ from one 'moderately motivated' ($p = 0.033$) and three 'highly motivated' ($p = 0.033$). The scores of the remaining clusters did not significantly differ (cluster three: 7.9 ± 9.6; cluster one: 7.4 ± 7.9, $p = 0.029$, $p = 0.527$).

Previously completed physiotherapy sessions

Different score distributions were found within the clusters ($\chi2(2) = 6.198$, $p = 0.045$, $\eta2 = 0.04$ – small effect size). It was revealed that participants belonging to cluster two 'controlled convinced' underwent up to twice as much physiotherapy sessions (10.5 ± 8.7, $p = 0.045$) as participants belonging to cluster three 'highly motivated' (5.0 ± 5.5, $p = 0.045$) or one 'moderately motivated' (4.8 ± 4.2, $p = 0.045$). Cluster two 'controlled convinced' differs significantly from cluster one 'moderately motivated' ($p = 0.046$) and cluster three 'highly motivated' ($p = 0.046$). Cluster one 'moderately motivated' and cluster three 'highly motivated' did not significantly differ ($p = 0.874$).

Anthropometric and socio-economic characteristics

BMI

Different BMI score distributions were found within the clusters ($F(2,100) = 4.188$, $p = 0.018$, $\eta^2 = 0.08$ - moderate effect size). The highest scores were found in participants in cluster two 'controlled convinced' (31.6 ± 5.9, $p = 0.018$), which significantly differed from cluster three 'highly motivated' (27.5 ± 5.0, $p = 0.020$). Cluster one 'moderately motivated' (29.4 ± 5.0, $p = 0.018$) was not significantly different from cluster two 'controlled convinced' ($p = 0.372$) or cluster three 'highly motivated' ($p = 0.219$).

Sex, age, educational qualification, financial status

No significant distribution differences between the three clusters were found for sex ($\chi2(2) = 1.627$, $p = 0.443$, $V = 0.13$), age ($F(2,100) = 2.301$, $p = 0.105$, $\eta2 = 0.04$), educational qualification ($\chi2(4) = 3.360$, $p = 0.500$, $V = 0.13$) or financial status ($p = 0.862$, $V = 0.07$).

Discussion

The goal of this study was to clarify the quality of exercise motivation in patients with CLBP. Our aim was not only to describe the representation of individual subscales but also to explore their interaction within motivational profiles (clusters). Three distinct clusters were identified: two characterized by autonomous motivation and one exhibiting lower, more controlled motivation to exercise.

Participants in the 'highly motivated' cluster showed the greatest proportional difference between controlled

and autonomous motivation. They achieved the highest scores in all forms of autonomous motivation and the highest RAI scores. This suggests that these patients perceive exercise as necessary and meaningful, with intrinsic enjoyment. However, moderate scores in introjected regulation suggest a degree of guilt or obligation, indicating that their motivation may not be purely intrinsic.

In the 'moderately motivated' cluster, participants displayed a similar motivational pattern, with lower overall values compared to the 'highly motivated' cluster. These patients showed low scores in controlled motivation and moderate to high scores in autonomous forms, indicating that they also perceive the importance of exercise, though identified motivation was more dominant in this group.

The 'controlled convinced' cluster displayed a distinct motivational pattern. While they scored similarly to the other groups in autonomous motivation, they also had elevated controlled motivation. This suggests that while these individuals recognize the benefits of exercise, their motivation is driven more by external pressures and feelings of guilt, making their behavior more ambivalent.

This cluster also exhibited significantly higher scores in measures of functioning and disability, duration of pain, physiotherapy sessions, and BMI. These findings align with previous research showing a negative correlation between controlled motivation and exercise adherence [39]. Given the complexity of motivational factors, tailored interventions focusing on enhancing autonomous motivation, such as cognitive behavioral therapy, motivational interviewing, and goal-setting strategies, could potentially improve outcomes for this group [40]. However, our study only demonstrated associations, and further research is needed to confirm any direct causal effects.

Given the well-documented effectiveness of regular exercise in reducing the impact of CLBP on pain and disability [7, 41, 42], it is possible that participants in this group struggled to adhere to their home exercise programs, which could partially explain their poorer outcomes.

Incorporating Self-Determination Theory in these interventions, which addresses autonomy, competence, and relatedness, may further enhance patient engagement and long-term adherence to exercise regimens, as recent research indicates that applying Self-Determination Theory in CLBP rehabilitation programs has been associated with improved quality of life and reduces disability [43].

In the context of the Czech Republic, where physiotherapy is fully covered by health insurance, this lack of adherence may be further influenced by passive coping behaviors. These patients may rely excessively on external interventions such as heat, cold, or electrotherapy, which, while commonly used and beneficial in some cases, may be over-relied upon, leading to dependency and a cycle of pain and disability [44, 45]. Studies have shown that patients receiving compensable care tend to have lower adherence to clinic-based advice, which might further contribute to this issue [46].

Clinical implications

Our findings emphasize that patients are not motivated by a single type of motivation, highlighting the importance of considering the proportional distribution of motivational subscales in clinical practice. The presence of controlled motivation is strongly associated with treatment adherence, which in turn influences treatment effectiveness in terms of functioning, disability, and related outcomes. This complexity in adherence aligns with recent findings that show no clear relationship between adherence to exercise and clinical outcomes, suggesting that factors beyond simple adherence must be addressed [47].

This is particularly relevant for the 'controlled convinced' cluster, which represents a small group of patients who may benefit from motivation-oriented interventions. Identifying such patients early in their treatment could help clinicians implement strategies aimed at enhancing autonomous motivation, potentially preventing non-adherence and improving rehabilitation outcomes. To address this, interventions tailored to individual patient needs, based on motivational profiles, can play an important role, as evidence supports the effectiveness of tailored, biopsychosocial approaches in improving long-term LBP outcomes [48].

Limitations

The limitations of this study are primarily related to the sample size. While a larger sample would have allowed for more precise clustering and more robust statistical power, time constraints and the limited size of the available population made it difficult to recruit additional participants. This limitation may reduce the reliability of the clustering results and their applicability to broader populations. Additionally, the homogeneity of the sample, primarily consisting of white, educated participants due to the demographic composition of the recruitment site, limits the generalizability of the findings. The results may not be applicable to populations with different cultural, socioeconomic, or educational backgrounds, and further studies are needed to explore these aspects in more diverse cohorts. Cultural and social factors, which may also influence motivational dynamics, were not explored in this study.

Another limitation is the underrepresentation of patients with lower educational backgrounds, which we attribute to the voluntary nature of recruitment. Individuals with higher education are more likely to participate

in such studies, leading to a skewed sample that may not fully reflect the motivational characteristics of the broader patient population. Furthermore, the fact that physiotherapy was prescribed by different physicians, potentially creating varying initial therapeutic climates, could have influenced the representation of specific motivational subscales and added variability to the study outcomes.

Conclusion

This study is the first to investigate the quality of exercise motivation in patients with CLBP. Our findings indicate that patients can be categorized into distinct motivational clusters, with autonomous motivation predominating across all groups. However, a significant proportion of controlled motivation was also observed within the sample.

Looking ahead, further longitudinal studies are needed to not only examine patients' initial motivation but also to explore how therapeutic interventions influence motivation over time. These insights primarily consisting of white, educated participants due to the demographic composition of the recruitment site, limits the generalizability of the findings. The results may not be applicable to populations with different cultural, socioeconomic, or educational backgrounds, and further studies are needed to explore these aspects in more diverse cohorts.

Abbreviations

CLBP	Chronic low back pain
LBP	Low back pain
SDT	Self-determination theory
SRQ-E	Exercise self-regulation questionnaire
SRQ	Self-regulation questionnaire
RMQ	Roland-Morris questionnaire
RAI	Relative autonomy index
BMI	Body mass index

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-025-08461-x.

Supplementary Material 1

Supplementary Material 2

Acknowledgements

NA.

Author contributions

The authors confirm contribution to the paper as follows: study conception and design: MN and LB; data collection: MN and FD; analysis and interpretation of results: FZ and MN; draft manuscript preparation: MN, LB, FZ and JS. All authors reviewed the results and approved the final version of the manuscript.

Funding

This work was supported by Ministry of Health of the Czech Republic (University Hospital Brno, 65269705), Internal grant NIG 02/22.

Data availability

All data, analysis code, and research materials are available upon request by the corresponding author.

Declarations

Ethics approval and consent to participate

The study received approval from the Internal Review Board of the Ethical Committee at University Hospital Brno, Czech Republic (approval number 03-170822/EK, dated August 17, 2022). All participants provided informed consent in compliance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Rehabilitation and Sports Medicine, 2nd Faculty of Medicine, Charles University, University Hospital Motol, Prague, Czech Republic
[2]Department of Rehabilitation, University Hospital Brno, Brno, Czech Republic
[3]Department of Physical Activities and Health Sciences, Faculty of Sport Studies, Masaryk university, Brno, Czech Republic
[4]Department of Rehabilitation, Faculty of Medicine, Masaryk university, Brno, Czech Republic
[5]Department of Physiotherapy and Rehabilitation, Faculty of Medicine, Masaryk University, Brno, Czech Republic
[6]School of Nursing, Tung Wah College, Hong Kong, China
[7]Department of Public Health, Faculty of Medicine, Masaryk University, Brno, Czech Republic

Received: 1 August 2024 / Accepted: 20 February 2025
Published online: 06 March 2025

References

1. Tagliaferri SD, Miller CT, Owen PJ, Mitchell UH, Brisby H, Fitzgibbon B et al. Domains of chronic low back pain and assessing treatment effectiveness: A clinical perspective. Pain Pract. 2020;20(2):211–25. Available from: https://doi.org/10.1111/papr.12846
2. Chen S, Chen M, Wu X, Lin S, Tao C, Cao H et al. Global, regional and national burden of low back pain 1990–2019: A systematic analysis of the Global Burden of Disease study 2019. J Orthop Translat. 2022;32:49–58. Available from: https://doi.org/10.1016/j.jot.2021.07.005
3. Fairbank J, Gwilym SE, France JC, Daffner SD, Dettori J, Hermsmeyer J et al. The role of classification of chronic low back pain. Spine (Phila Pa 1976). 2011;36:S19–42. Available from: https://doi.org/10.1097/brs.0b013e31822ef72c
4. Coudeyre E, Tubach F, Rannou F, Baron G, Coriat F, Brin S et al. Fear-avoidance beliefs about back pain in patients with acute LBP. Clin J Pain. 2007;23(8):720–5. Available from: https://doi.org/10.1097/AJP.0b013e31814da407
5. Urits I, Burshtein A, Sharma M, Testa L, Gold PA, Orhurhu V et al. Low back pain, a comprehensive review: Pathophysiology, diagnosis, and treatment. Curr Pain Headache Rep. 2019;23(3). Available from: https://doi.org/10.1007/s11916-019-0757-1
6. Liddle SD, Baxter DG, Gracey JH. Exercise and chronic low back pain: what works? Pain. 2004;107(1):176–90. Available from: https://doi.org/10.1016/j.pain.2003.10.017
7. Paolucci T, Attanasi C, Cecchini W, Marazzi A, Capobianco SV, Santilli V. Chronic low back pain and postural rehabilitation exercise: a literature review. J Pain Res. 2019;12:95–107. Available from: https://doi.org/10.2147/JPR.S171729
8. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, van Tulder MW. Exercise therapy for chronic low back pain. Cochrane Libr. 2021;2021(10). Available from: https://doi.org/10.1002/14651858.cd009790.pub2

9. Wilson PM, Mack DE, Grattan KP. Understanding motivation for exercise: A self-determination theory perspective. Can Psychol. 2008;49(3):250–6. Available from: https://doi.org/10.1037/a0012762
10. Polaski AM, Phelps AL, Kostek MC, Szucs KA, Kolber BJ. Exercise-induced hypoalgesia: A meta-analysis of exercise dosing for the treatment of chronic pain. PLoS One. 2019;14(1):e0210418. Available from: https://doi.org/10.1371/journal.pone.0210418
11. Rice D, Nijs J, Kosek E, Wideman T, Hasenbring MI, Koltyn K et al. Exercise-induced hypoalgesia in pain-free and chronic pain populations: State of the art and future directions. J Pain. 2019;20(11):1249–66. Available from: https://doi.org/10.1016/j.jpain.2019.03.005
12. Chen KK, Rolan P, Hutchinson MR, Dickson C, de Zoete RMJ. Exercise-induced changes in central sensitization outcomes in individuals with chronic musculoskeletal pain: A systematic review with meta-analysis. Eur J Pain. 2024; Available from: https://doi.org/10.1002/ejp.2277
13. Hayden JA, Ellis J, Ogilvie R, Stewart SA, Bagg MK, Stanojevic S et al. Some types of exercise are more effective than others in people with chronic low back pain: a network meta-analysis. J Physiother. 2021;67(4):252–62. Available from: https://doi.org/10.1016/j.jphys.2021.09.004
14. Mahindru A, Patil P, Agrawal V. Role of physical activity on mental health and well-being: A review. Cureus. 2023; Available from: https://doi.org/10.7759/cureus.33475
15. Müller G, Pfinder M, Clement M, Kaiserauer A, Deis G, Waber T et al. Therapeutic and economic effects of multimodal back exercise: A controlled multicentre study. J Rehabil Med. 2019;51(1):61–70. Available from: https://doi.org/10.2340/16501977-2497
16. Friedrich M, Gutter G, Harberstadt Y, Cormack A, Heiller I. Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain. A randomised controlled trial. Arch Phys Med Rehabil. 1998;79:475–87.
17. Middleton A. Chronic low back pain: Patient compliance with physiotherapy advice and exercise, perceived barriers and motivation. Phys Ther Rev. 2004;9(3):153–60. Available from: https://doi.org/10.1179/108331904225006312
18. Kleinert J, Ott I, Mierswa T, Levenig CG, Wenge K, Hasenbring M et al. Exercise motivation and nonspecific back pain: A comparison of patients and nonpatients. Rehabil Psychol. 2017;62(3):363–73. Available from: https://doi.org/10.1037/rep0000149
19. van Middelkoop M, Rubinstein SM, Verhagen AP, Ostelo RW, Koes BW, van Tulder MW. Exercise therapy for chronic nonspecific low-back pain. Best Pract Res Clin Rheumatol. 2010;24(2):193–204. Available from: https://doi.org/10.1016/j.berh.2010.01.002
20. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. J Pers Soc Psychol. 1989;57(5):749–61. Available from: https://doi.org/10.1037//0022-3514.57.5.749
21. Howard J, Gagné M, Morin AJS, Van den Broeck A. Motivation profiles at work: A self-determination theory approach. J Vocat Behav. 2016;95–96:74–89. Available from: https://doi.org/10.1016/j.jvb.2016.07.004
22. Chan DK, Lonsdale C, Ho PY, Yung PS, Chan KM. Patient motivation and adherence to postsurgery rehabilitation exercise recommendations: The influence of physiotherapists' autonomy-supportive behaviors. Arch Phys Med Rehabil. 2009;90(12):1977–82. Available from: https://doi.org/10.1016/j.apmr.2009.05.024
23. Markland D, Tobin V. A modification to the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. J Sport Exerc Psychol. 2004;26(2):191–6. Available from: https://doi.org/10.1123/jsep.26.2.191
24. Guay F. Applying self-determination theory to education: Regulations types, psychological needs, and autonomy supporting behaviors. Can J Sch Psychol. 2022;37(1):75–92. Available from: https://doi.org/10.1177/08295735211055355
25. Joshua Howard Marylène, Gagné, Alexandre JS, Morin. Anja Van Den broeck,motivation profiles at work: A self-determination theory approach,journal of vocational behavior,95–96,2016,Pages 74–89,ISSN 0001-8791,https://doi.org/10.1016/j.jvb.2016.07.004
26. Vlachopoulos Symeon P, Costas I, Karageorghis, Peter C, Terry. Motivation Profiles in Sport: A Self-Determination Theory Perspective. Research Quarterly for Exercise and Sport 71 (4): 387–97. Available from: https://doi.org/10.1080/02701367.2000.10608921
27. Hurkmans EJ, Maes S, de Gucht V, Knittle K, Peeters AJ, Ronday HK et al. Motivation as a determinant of physical activity in patients with rheumatoid arthritis. Arthritis Care Res (Hoboken). 2010;62(3):371–7. Available from: https://doi.org/10.1002/acr.20106
28. Diez-Buil H, Hernandez-Lucas P, Leirós-Rodríguez R, Echeverría-García O. Effects of the combination of exercise and education in the treatment of low back and/or pelvic pain in pregnant women: Systematic review and meta-analysis. Int J Gynaecol Obstet. 2024;164(3):811–22. Available from: https://doi.org/10.1002/ijgo.15000
29. Murray A, Hall AM, Williams GC, Mcdonough SM, Ntoumanis N, Taylor IM. Effect of a Self-Determination Theory-Based communication skills training program on physiotherapists' psychological support for their patients with chronic low back pain: A randomized controlled trial. Arch Phys Med Rehabil. 2015;96:809–16.
30. Friedrich M, Gittler G, Halberstadt Y, Cermak T, Heiller I. Combined exercise and motivation program: Effect on the compliance and level of disability of patients with chronic low back pain: A randomized controlled trial. Arch Phys Med Rehabil. 1998;79(5):475–87. Available from: https://doi.org/10.1016/s0003-9993(98)90059-4
31. Holden J, Davidson M, O'Halloran P. Motivational strategies for returning patients with low back pain to usual activities: A survey of physiotherapists working in Australia. Man Ther. 2015;20(6):842–9. Available from: https://doi.org/10.1016/j.math.2015.04.005
32. O'Riordan C, Clifford A, Van De Ven P, Nelson J. Chronic neck pain and exercise interventions: Frequency, intensity, time, and type principle. Arch Phys Med Rehabil. 2014;95(4):770–83. Available from: https://doi.org/10.1016/j.apmr.2013.11.015
33. Lewit K, Kobesova A, Soft Tissue, Manipulation. Rehabilitation of the Spine. A Practitioner's Manual. 2nd ed, Lippincott Williams&Wilkins. 2006;388–402.
34. Frank C, Kobesova A, Kolar P. Dynamic neuromuscular stabilization & sports rehabilitation. Int J Sports Phys Ther. 2013;8(1):62–73. PMID: 23439921; PMCID: PMC3578435.
35. Dalmaijer ES, Nord CL, Astle DE. Statistical power for cluster analysis. BMC Bioinformatics. 2022;23:205. https://doi.org/10.1186/s12859-022-04675-1
36. Brown JM, Miller WR, Lawendowski LA. The self-regulation questionnaire. Innovations Clin Practice: Sourceb. 1999;17:281–92.
37. Gavora P, Jakešová J, Kalenda J. The Czech validation of the self-regulation questionnaire. Procedia Soc Behav Sci. 2015;171:222–30. Available from: https://doi.org/10.1016/j.sbspro.2015.01.113
38. Roland MO, Morris RW. A study of the natural history of back pain. Part 1: development of a reliable and sensitive measure of disability in low back pain. Spine. 1983;8:141–4.
39. Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: A systematic review. Int J Behav Nutr Phys Act. 2012;9(1):78. Available from: https://doi.org/10.1186/1479-5868-9-78
40. Holden J, Davidson M, O'Halloran P. Motivational strategies for returning patients with low back pain to usual activities: A survey of physiotherapists working in Australia. Man Ther. 2015;20(6):842–9. https://doi.org/10.1016/j.math.2015.04.005
41. Malfliet A, Ickmans K, Huysmans E, Coppieters I, Willaert W, Van Bogaert W et al. Best evidence rehabilitation for chronic pain part 3: Low Back Pain. J Clin Med. 2019;8(7):1063. Available from: https://doi.org/10.3390/jcm8071063
42. Shiri R, Coggon D, Falah-Hassani K. Exercise for the prevention of low back pain: Systematic review and meta-analysis of controlled trials. Am J Epidemiol. 2018 [cited 2024 Feb 27];187(5):1093–101. Available from: https://academic.oup.com/aje/article/187/5/1093/4557909
43. Navas-Otero A, Calvache-Mateo A, Martín-Núñez J et al. The Effectiveness of Combined Exercise and Self-Determination Theory Programmes on Chronic Low Back Pain: A Systematic Review and Metanalysis. Healthcare (Basel). 2024;12(3):382. Published 2024 Feb 1. https://doi.org/10.3390/healthcare12030382
44. Higuchi D. Adaptive and maladaptive coping strategies in older adults with chronic pain after lumbar surgery. Int J Rehabil Res. 2020;43(2):116–22. Available from: https://doi.org/10.1097/mrr.0000000000000389
45. Mercado AC, Carroll LJ, Cassidy JD, Côté P. Passive coping is a risk factor for disabling neck or low back pain. Pain. 2005;117(1–2):51–7. Available from: https://doi.org/10.1016/j.pain.2005.05.014
46. Kolt GS, McEvoy JF. Adherence to rehabilitation in patients with low back pain. Man Ther. 2003;8(2):110–6. Available from: https://doi.org/10.1016/s1356-689x(02)00156-x
47. Arensman RM, Pisters MF, Kloek CJJ, Koppenaal T, Veenhof C, Ostelo RJWG. Exploring the association between adherence to home-based exercise recommendations and recovery of nonspecific low back pain: a prospective cohort study. BMC Musculoskelet Disord. 2024;25(1):614. Published 2024 Aug 1. https://doi.org/10.1186/s12891-024-07705-6

48. Hubeishy MH, Rossen CB, Dannapfel P et al. Developing a low back pain guideline implementation programme in collaboration with physiotherapists and chiropractors using the Behaviour Change Wheel: a theory-driven design study. Implement Sci Commun. 2024;5(1):33. Published 2024 Apr 3. https://doi.org/10.1186/s43058-024-00568-x

Publisher's note