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Factors associated with disability for low back pain based on the
biopsychosocial model.

(生物心理社会モデルに基づく腰痛の障害に関連する因子の検討)

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Abstract

This dissertation aimed to clarify the elements influencing disability in low back pain (LBP) and emphasized the essential role of the biopsychosocial (BPS) model in comprehensive treatment for LBP. This dissertation consisted of three studies.

Study 1:

The first study, a systematic review and meta-analysis, highlighted the marked effectiveness of biopsychosocial interventions over traditional methods, signaling a fundamental shift in LBP management by endorsing an approach that integrates psychological and social factors with biological considerations. The results supported the view that physical therapist-led interventions based on the BPS model were more effective than non-BPS model-based interventions in improving pain and disability.

Study 2:

The second study examined how psychological factors affects disability in non-specific low back pain (NSLBP). This segment of the research focused on a robust analysis of 235 patients, segmented into acute ($n=124$) and non-acute groups ($n=111$). The study measured disability levels, correlating them with various factors such as pain intensity and psychosocial elements, notably pain catastrophizing, fear of movement, and pain self-efficacy. The study utilized a hierarchical multivariate regression analysis. Those significant relations to disability were pain self-efficacy ($\beta = -0.361$; $p < 0.01$), pain intensity ($\beta = 0.280$; $p < 0.01$) and pain catastrophizing ($\beta = 0.209$; $p < 0.05$) for acute group. Only pain self-efficacy having the most significant association on disability of the non-acute group ($\beta = -0.416$; $p < 0.01$). In conclusion, the factors associating with disability differed depending on the duration of the disease, and pain self-efficacy might be one of the factors associating with disability of patients with NSLBP.

Study 3:

The third study investigated psychological factors in pre-surgical assessments for LBP, exploring factors related to disability in post-surgical LBP. This exploration was anchored in a retrospective longitudinal study involving 176 participants, meticulously assessing the interplay

between various preoperative factors and post-surgical disability outcomes. Data on pain intensity, disability, and a spectrum of psychosocial factors were collected pre-surgery, with follow-up assessments conducted more than a year post-surgery. The study employed a nuanced hierarchical multivariate regression analysis, with the disability as the dependent variable. This analysis was multifaceted, considering preoperative scores, participant demographics, pain scales, and a range of psychological assessments, including the Pain Catastrophizing Scale, Tampa Scale for Kinesiophobia, and Hospital Anxiety and Depression Scales. Preoperative fear of movement, quantified by the Tampa Kinesiophobia Scale, emerged as a strong predictor of postoperative disability ($B = -0.107$; $p < 0.05$). As a result of this study, the research highlighted the critical impact of preoperative psychological factors, particularly fear of movement, on postoperative outcomes.

Discussion:

The findings from the three studies collectively highlight that LBP is a condition with various causes, not a uniform one. The BPS model is an effective approach in this area because of its consideration of many different factors. It allows for the integration of a wide range of factors – biological, psychological, and social – that play a crucial role in the patient's experience of pain and disability. The studies underscore the importance of not only addressing the physical aspects of LBP but also considering the psychological and social dimensions that significantly impact the patient's recovery and quality of life. This approach is especially relevant given the findings that psychological factors such as pain self-efficacy and fear of movement can have a profound influence on the outcomes of both non-surgical and surgical treatments for LBP.

Conclusion:

This dissertation reveals that disability in LBP varies greatly, influenced by the condition's type and stage. It highlights the need for personalized treatment approaches, recognizing the unique challenges each patient faces. The BPS model proves effective, integrating diverse factors affecting LBP.

Chapter 1. Introduction

Epidemiology of low back pain

Low back pain (LBP) is one of the most prevalent global health issues, alongside other spinal disorders like neck pain [1]. According to a previous study, LBP is the leading cause of global productivity loss measured in years and the leading cause of years lived with disability in 126 countries [2]. One study reported that back pain was the most common in middle-aged women between the ages of 40 and 80 years old, with a prevalence of 12% and a one-month prevalence of 23% [3]. The study also reported the prevalence of LBP increases with age, from about 5% in children aged 7–10 years, to 20% in adolescents, peaking at 30–40% in those aged 40–69 years [3]. The incidence of LBP was also reported to be higher in high-income countries than in low- or middle-income countries, which explains why back pain is considered as a lifestyle disease [4]. In terms of clinical presentation, disability stands out as a significant outcome, often manifesting as physical impairments that affect a person's mobility, capacity, and daily activities [5].

Types of low back pain

LBP is complex and can be classified into several types from several perspectives. Based on the mechanism of pain, LBP can be classified as mechanical, neuropathic, or nociceptive [4]. Among them, nociceptive pain, in which the primary pathology is central sensitization, is the newest category of pain [6]. In addition, LBP with identifiable pathogenesis can be broadly classified. These include lumbar disc herniation, lumbar spinal stenosis, lumbar spondylolysis, and nonspecific LBP (NSLBP) [4]. NSLBP is defined as low sensitivity and specificity of pain source, where several lumbar structures are possible pain sources, but clinical examination cannot determine that the pain is due to these structures [4]. One previous study showed that 90% of LBP is non-specific [5]. Some severe LBP require surgery. In most cases, surgery

improves pain and disability [7]. However, in some cases where the procedure has been considered anatomically successful, the patients had residual disabilities and could not return to work [8].

LBP can also be divided into acute LBP and chronic LBP according to the time of the onset. Commonly, most cases of acute back pain recover completely within 4 to 6 weeks [9]. In some LBP, however, symptoms persist and become chronic phase. Chronicity is caused by a variety of biological, psychological, social, and work-related factors. A review of predictive factors for LBP found that high disability, presence of sciatica, older age, poor general health, increased psychological and psychosocial distress, negative cognitive traits, poor relationships with colleagues, high physical workload, and compensation were associated with poor outcomes [8]. Psychological factors are also involved in postoperative LBP as a cause of lack of improvement in pain and disability [10]. Therefore, a multidimensional assessment that includes not only biomedical but also psychological and social factors is necessary [11]. Owing to the wide range of etiologies for the associated pain and disability, including biological and psychosocial factors, the latest guidelines worldwide recommend interventions based on the biopsychosocial (BPS) model for spinal disorders [12, 13].

Association of the biopsychosocial model with low back pain

In recent years, LBP is often not diagnosed by imaging alone. In fact, routine imaging is not recommended by guidelines [14]. Additionally, one study indicated that there was no consistent association between MRI findings and future episodes of LBP [15]. Imaging studies may reveal incidental findings that are not related to the source of the pain [15]. For instance, the prevalence of disc bulges in asymptomatic individuals has been shown to increase from 30% at age 20 to 60% at age 50, and to 84% at age 80 [16].

Beyond imaging, many factors such as a patient's character, pain intensity, and psychosocial elements are known to influence LBP disability [8]. Of these factors, psychological ones have garnered increasing attention recently. For example, fear of movement, pain catastrophic thinking, and self-efficacy have been identified as psychosocial factors associated with NSLBP in previous studies [17]. Alamam et al. reported that the factors that contributed to chronicity after one year were high fear of movement and older age and the intensity of pain at the beginning of the disease [18]. Fear of movement is an important predictor of failure to return to work, and it is believed to contribute to disability of NSLBP [19, 20]. In terms of self-efficacy, it (self-efficacy?) is related to pain intensity and disability, but a correlation between low self-efficacy and physical function has been reported [21]. For example, stability during lifting movements were reduced of NSLBP patients with low self-efficacy [22]. In addition, Wertli et al. reported that catastrophic thinking is associated with disability and may contribute to chronicity [23]. Thus, from previous studies, it is clear that many psychological factors are involved in disability of NSLBP. However, no study has examined which factors have more impact on disability of NSLBP. Furthermore, most of such studies were on non-acute NSLBP, not acute NSLBP. The important aspect of NSLBP is to take appropriate action of the acute phase to prevent it from becoming chronicity. This is because it is difficult to identify and remedy the causes of chronic conditions [4]. Depending on the duration of the disease, factors associating with disability of NSLBP may differ. Identifying factors that influence disability of the acute and non-acute phase provides appropriate interventions for at each phase and important information to prevent chronicity.

Also, many previous studies have examined preoperative factors that affect disability after surgery for LBP. For example, the degree of preoperative nerve compression has been considered a predictor of poor outcomes [24]. Hebert et al. found that demographic, health, and clinical factors were better predictors of pain and disability preoperatively than surgery-related factors, such as waiting time for surgery and the surgical technique for degenerative lumbar

spinal stenosis [25]. More recently, there has been growing interest in the role of psychological factors in influencing postoperative outcomes. Systematic reviews of lumbar spinal stenosis have reported that periprosthetic depression is a prognostic factor for disability [26, 27]. Furthermore, preoperative psychological factors influence disability and quality of life (QoL) at 6 months and 1 year postoperatively in patients with degenerative diseases of the lumbar spine [28]. Another study found that preoperative anxiety and depression were predictive of disability and QOL 1 year after surgery in patients who underwent lumbar discectomy [29]. Furthermore, pain catastrophizing is a representative psychological factor that can predict pain and disability after lumbar surgery [23]. Fear of movement has also been reported to predict postoperative outcomes after spinal surgery [30].

Purpose

LBP is recognized as a significant global health concern due to its intricate nature and multifaceted causes. While numerous factors influencing LBP disability have been explored in previous studies, it is believed that considering each LBP classification is essential, given the distinct factors affecting each cause and onset. The purpose of this dissertation was to examine factors related to disability in LBP by classification based on the biopsychosocial model. Specifically, LBP was classified into two subcategories: LBP with a specific pathology and NSLBP in which the pathology is unclear. NSLBP was classified as either acute or chronic. This dissertation is comprised of three distinct studies. Initially, the significance of the BPS model was underscored by systematically summarizing and analyzing the impact of BPS-based interventions on disability through a meta-analysis targeting spinal disorders. Second, factors influencing disability were examined for NSLBP in the acute and post-acute phases, with a focus on psychological factors. In the last study, factors affecting disability in LBP with surgical indications were examined based on psychological factors.

Chapter 2.

Physical therapist-led interventions based on the Biopsychosocial Model provide improvement in disability and pain for spinal disorders: A systematic review and meta-analysis

Objective

The management of spinal disorders, including LBP, recommends a multifaceted intervention based on the BPS model [4]. Interventions based on the BPS model often combine psychological techniques, such as cognitive behavioral therapy, pain neuroscience education, and coping skills using a graded activity with physical interventions [31]. Ideally, these interventions should be performed by a multidisciplinary team; practically, physical therapists often have to perform these interventions alone due to a shortage of workforce and financial resources [32]. However, a study reported that physical therapists' efforts are marred by a lack of requisite understanding and confidence in the BPS model [33]. Accordingly, the effectiveness of physical therapist-led interventions based on the BPS model remains indeterminate and needs to be systematically summarized. Therefore, this study aimed to summarize the effectiveness of a physiotherapist-led intervention based on the BPS model for adults with spinal disorders (neck pain and LBP) in improving pain and disability compared with other interventions through a systematic review and meta-analysis of RCTs.

Methods

Identification and selection of trials

We searched the following databases from inception to October 27th, 2022: the Web of Science, CENTRAL, MEDLINE, PsycINFO, CINAHL and PEDro. It was manually searched the relevant literature cited in the studies. A systematic search strategy was developed using

medical subject heading (MeSH) terms and keywords generated from subject headings. The search strategies in can be found in appendix 1. We included only RCTs and published them in English. Grey media was excluded from this study. Participants included patients diagnosed with spinal disorders who received an intervention based on the BPS model by physical therapists. All types of spinal disorders and any symptom duration (acute, subacute and chronic) were included in this study. There were no restrictions on participants' gender, ethnicity or other demographic characteristics. The eligible interventions were interventions based on the BPS model by physical therapists. It was defined as physical therapists mainly performing both psychosocial and physical approaches. For example, it excluded cases in which psychological intervention was without physical intervention and cases with physical intervention without psychological interventions. All delivery forms were included, including group instruction, individual briefings, presentations, books and leaflets. The control group was the group that did not receive BPS intervention by physical therapists, such as only exercise, mobilization, and any only psychological approach.

Study inclusion and data extraction

Rayan software (available at <https://www.rayyan.ai/>) was used. Records from the titles and abstracts were independently assessed by the author to identify eligible studies. Subsequently, full-text screening was conducted by the same author to determine if the criteria were met.

Participant data were source and setting, age, gender, and symptom duration. Intervention data included a description, duration and number of sessions, and delivery type. Data for comparisons included type of intervention and duration or number of sessions. The primary outcome measures were pain intensity, disability. Secondary outcomes were psychological factors including fear of movement, catastrophizing, anxiety, depression, and self-efficacy. For pain intensity, patient-reported outcome measures (PROMs) such as numerical rating scales and visual analog scales were used if they were reported. For disability, PROMs such as neck

disability index (NDI) for neck disability and Oswestry Disability Index (ODI) or Roland-Morris Disability Questionnaire (RDQ) for the low back were used for analysis. It included outcomes means and standard deviations (SDs) for pain, disability, and psychological factors during short-, medium- and long-term follow-ups. Short term was defined as <3 months, medium-term as ≥ 3 months to 12 months and long term as ≥ 12 months [34].

Means and SDs were attempted using each follow-up point. For studies in which the SD for each intervention group was not presented, the group mean was calculated from the standard error, confidence interval, and p-value of the difference between the means [35]. In studies where the SD was not stated and only the median and interquartile range values were reported, the median was replaced with the mean and the interquartile range width was used as an approximation of 1.35 times the SD [35]. If SD could not be extracted and was not provided by authors, it was imputed from a systematic review in the same analysis measuring the outcome on the same scale [35]. It was excluded studies from our meta-analysis if the reporting of results was unclear even after doing the above.

Assessment of methodological quality

The overall quality of evidence was assessed by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system [36]. It consists of five items: Risk of bias (RoB), inconsistency, indirectness, inaccuracy, and publication bias. Each item was rated as high, medium, low, or very low, and the lowest quality was selected as the overall quality of the evidence.

Data synthesis and analysis

A meta-analysis using Review Manager 5.4 (Nordic Cochrane Centre, København Ø, Denmark) was used when two or more studies showed the same outcomes. It was performed by examining pooled differences in pain intensity, disability, and psychological outcomes at

short-, mid-, and long-term follow-up. The standardized mean difference (SMD) was calculated for either the same or different patient-reported outcome measures for the same outcome. It was calculated using a random-effects model and 95% confidence interval (CI). Cohen's effect sizes were used, with 0.2 representing a small effect, 0.5 a moderate effect, and 0.8 a large effect. The I-squared (I^2) statistic was assessed for heterogeneity among trials, whose interpretations were as follows: 0%–40%, insignificant heterogeneity; 30%–60%, moderate heterogeneity; 50%–90%, substantial heterogeneity; and 75%–100%, considerable heterogeneity [35]. An effect size was considered small and not clinically significant if the effect size was smaller than 0.2 [37]. In addition, the subgroup analysis was divided into LBP group and neck pain group.

Results

The initial search identified 10,621 records, and after removing duplicates, 7,639 records were reviewed. Four hundred thirteen full texts were screened, and 64 trials were selected. Of the included studies, six [31, 38–42] were follow-ups after several years in the same subjects, and one [43] examined a different outcome in the same studies; therefore, they were combined and counted as one study or excluded. In results, 57 trials with 5471 individuals were included in this study. Figure 1 shows the flow of the study selection.

Characteristics of included trials and intervention description

Of the total 57 studies, 36 were for LBP with 3,648 individuals [21, 38, 44–77]. The number of studies on neck pain was 20 with 1,703 individuals [42, 78–96]. In only one study, the subject was whole spine disorder which was 120 individuals [97]. The maximum sample size was 402 (201/201), and the minimum was 12 (6/6). Thirty-eight of the studies had received training on the BPS model before the intervention (25 studies in the LBP group and 13 studies in the neck pain group). The 57 included studies were summarized using TIDieR and were shown in Appendix 1.

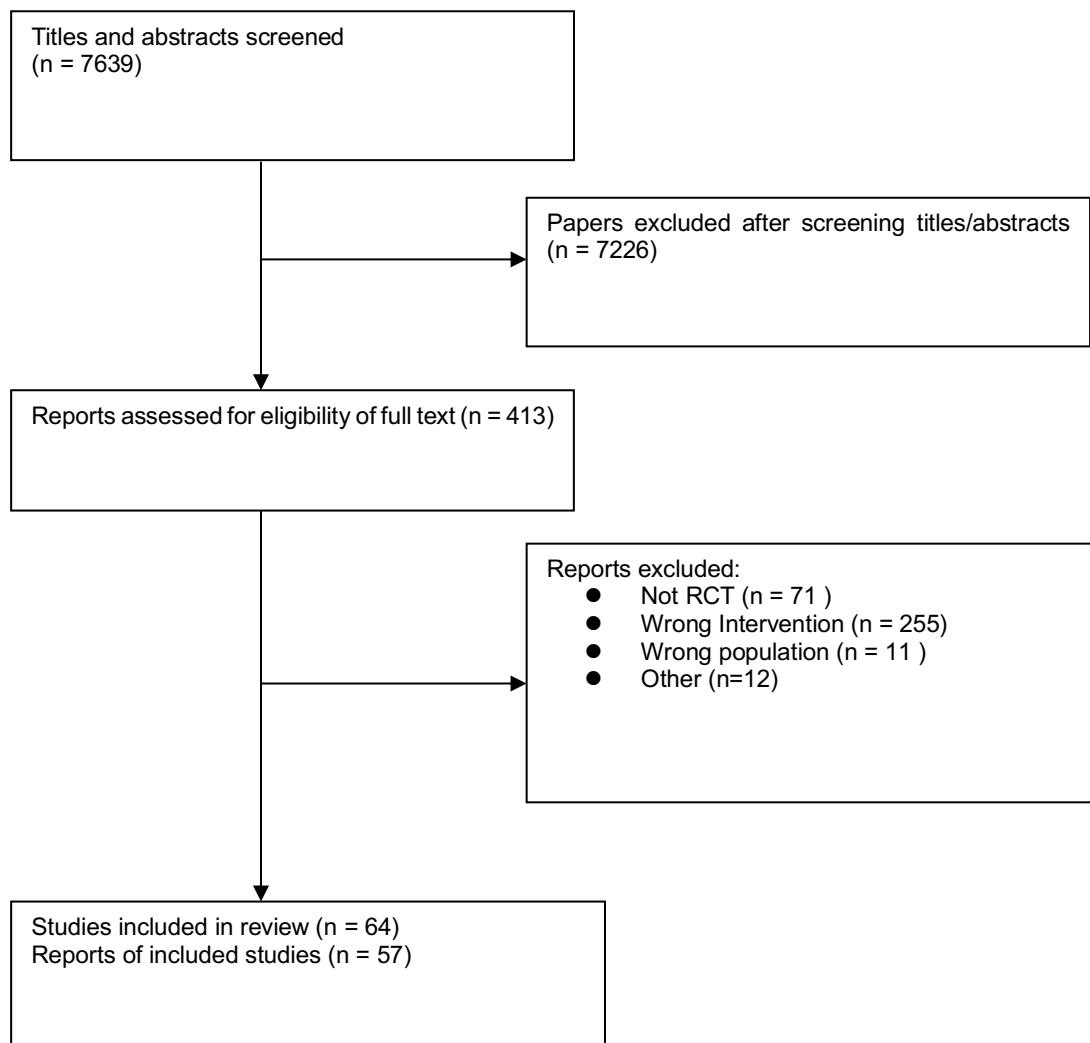


Figure 1. Flow of studies through the review.

* Papers may have been excluded for failing to meet more than one inclusion criteria.

Risk of bias assessment

Most of the included studies (51 of 57) were assessed as low risk of bias, defined as more than six on the PEDro scale (Appendix 2).

Certainty of the evidence according to the GRADE approach

The results of the certainty of the evidence using the GRADE approach were described in the results of each outcome. In addition, a table summarizing the results was provided in Appendix 3.

Synthesis of results: Meta-analysis

One study [67] was excluded from the meta-analysis for all outcomes because it was impossible to achieve exact means and SDs at each baseline follow-up point. The other study [88] excluded only the short term, which could not be obtained for the outcome, and included all other results in the meta-analysis.

Pain outcomes (Figure 2 to Figure 4)

For pain intensity, there was a statistically significant effect for the BPS model of intervention by physical therapist for the short term (37 trials with 2,695 individuals; SMD: -0.44 ; 95%CI: -0.62 to -0.27 ; $I^2=78\%$)(Figure 2), the medium term (38 trials with 4,201 individuals; SMD: -0.24 ; 95%CI: -0.37 to -0.12 ; $I^2=74\%$) (Figure 3) and the long term (24 trials with 2,991 individuals; SMD: -0.17 ; 95%CI: -0.28 to -0.06 ; $I^2= 56\%$) (Figure 4). Outcomes were clinically significant except in the long term. The quality of the evidence was low for all terms due to very serious inconsistency with two levels downgraded from GRADE score.

Low back pain subgroup (Figure 2 to Figure 4)

There was a statistically significant effect for short term (21 trials with 1,562 individuals; SMD:

-0.34; 95%CI: -0.52 to -0.16; $I^2 = 66\%$) (Figure 2), the medium term (24 trials with 2,672 individuals; SMD: -0.22; 95%CI: -0.40 to -0.03; $I^2 = 80\%$) (Figure 3) and the long term (14 trials with 1,884 individuals; SMD: -0.09; 95%CI: -0.24 to 0.06; $I^2 = 60\%$) (Figure 4). The clinical significance was found for the short and medium terms. The quality of the evidence was very low for short as well as medium terms due to very serious inconsistency and serious imprecision and low for the long term due to very serious inconsistency.

Neck back subgroup (Figure 2 to Figure 4)

There was a statistically significant effect for short term (16 trials with 1,133 individuals; SMD: -0.63; 95%CI: -0.97 to -0.29; $I^2 = 86\%$) (Figure 2), the medium term (15 trials with 1,409 individuals; SMD: -0.27; 95%CI: -0.43 to -0.11; $I^2 = 53\%$) (Figure 3) and the long term (9 trials with 987 individuals; SMD: -0.28; 95%CI: -0.45 to -0.12; $I^2 = 0\%$) (Figure 4). The clinical significance was found for all terms. The quality of the evidence was low for the short term due to very serious inconsistency, moderate for the medium term due to serious inconsistency, and high for the long term.

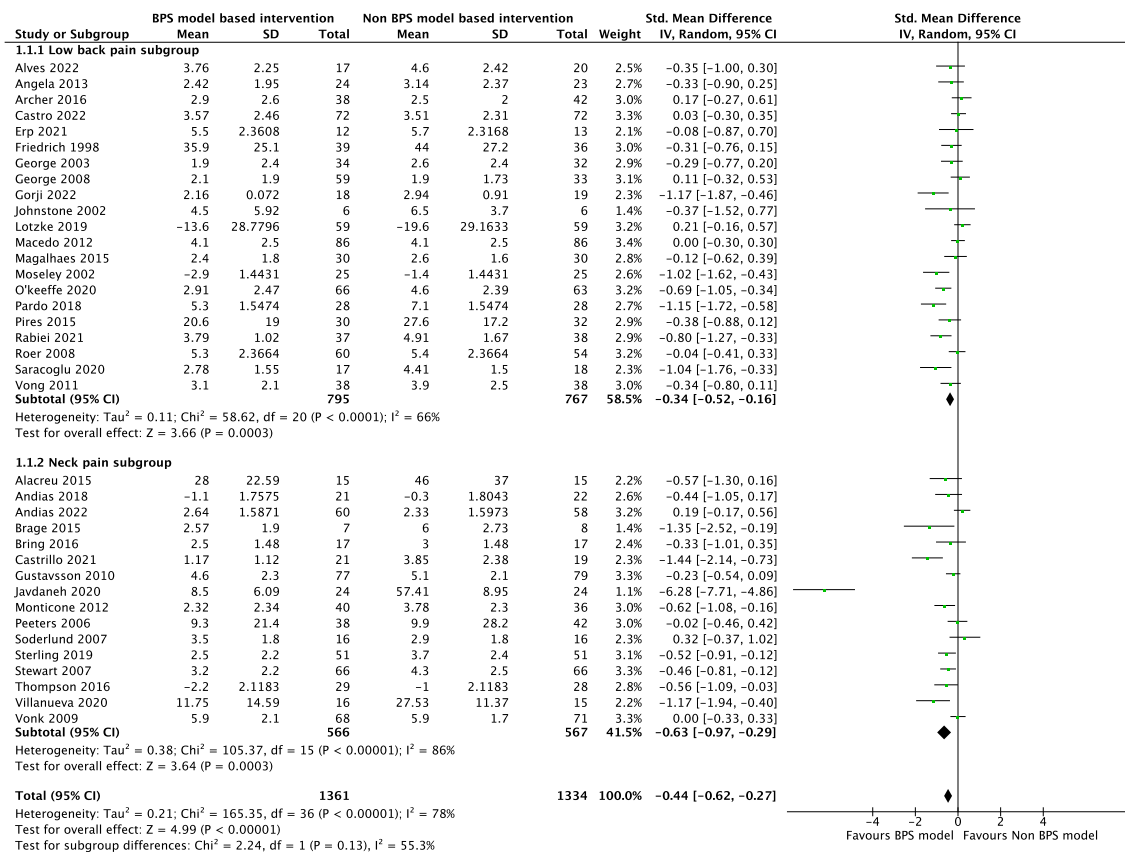


Figure 2. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on pain in the short term

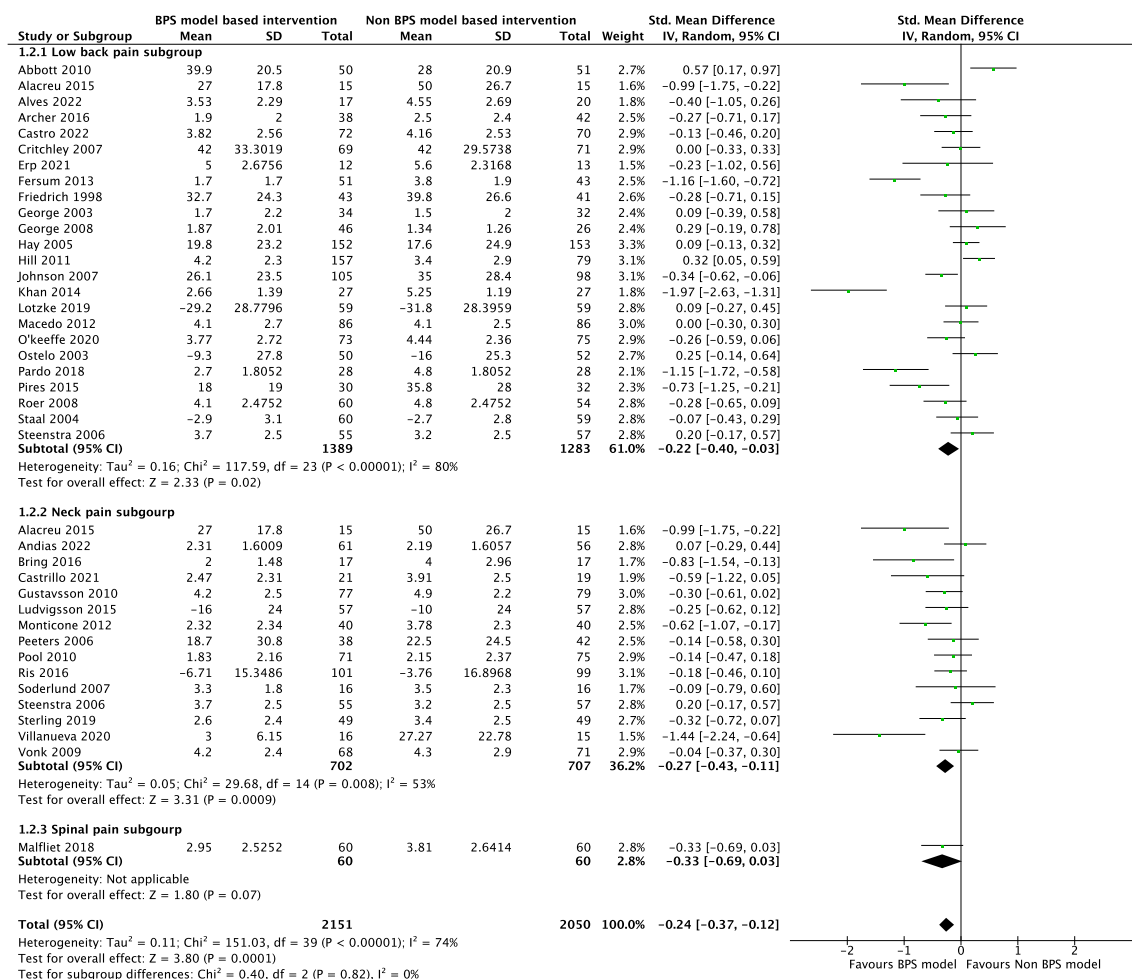


Figure 3. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on pain in the medium term

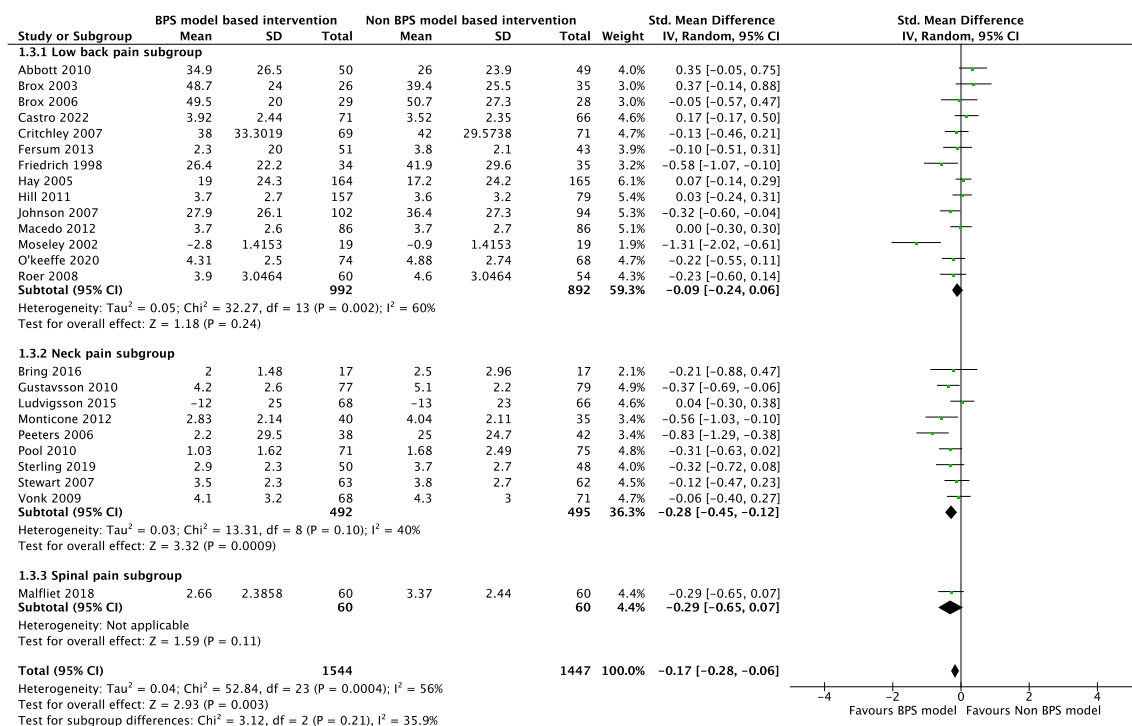


Figure 4. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on pain in the long term.

Disability outcome (Figure 5 to Figure 7)

For disability, there was a statistically significant effect for the BPS model of intervention by physical therapist for the short term (36 trials with 2,585 individuals; SMD: -0.48 ; 95%CI: -0.69 to -0.27 ; $I^2 = 84\%$) (Figure 5), the medium term (37 trials with 3,934 individuals; SMD: -0.44 ; 95%CI: -0.64 to -0.25 ; $I^2 = 88\%$) (Figure 6) and the long term (24 trials with 3,000 individuals; SMD: -0.37 ; 95%CI: -0.58 to -0.15 ; $I^2 = 88\%$) (Figure 7). The clinical significance was found in all terms. The quality of the evidence was low for all terms due to very serious inconsistency with two levels downgraded.

Low back pain subgroup (Figure 5 to Figure 7)

There was a statistically significant effect for short term (22 trials with 1,567 individuals; SMD: -0.42 ; 95%CI: -0.68 to -0.15 ; $I^2 = 84\%$) (Figure 5), and the medium term (24 trials with 2,665 individuals; SMD: -0.33 ; 95%CI: -0.53 to -0.13 ; $I^2 = 84\%$) (Figure 6) and the long term (14 trials with 1,866 individuals; SMD: -0.20 ; 95%CI: -0.39 to -0.02 ; $I^2 = 74\%$) (Figure 7). The clinical significance was found in all terms. The quality of the evidence was low for all terms due to very serious inconsistency.

Neck back subgroup (Figure 5 to Figure 7)

There was a statistically significant effect for short term (14 trials with 1,018 individuals; SMD: -0.60 ; 95%CI: -0.97 to -0.23 ; $I^2 = 87\%$) (Figure 5), the medium term (12 trials with 1,149 individuals; SMD: -0.38 ; 95%CI: -0.53 to -0.13 ; $I^2 = 69\%$) (Figure 6) and the long term (9 trials with 1,014 individuals; SMD: -0.28 ; 95%CI: -0.43 to -0.13 ; $I^2 = 30\%$) (Figure 7). The quality of the evidence was low for the short term due to very serious inconsistency, moderate for the medium term due to serious inconsistency, and high for the long term. The clinical significance was found in all terms.

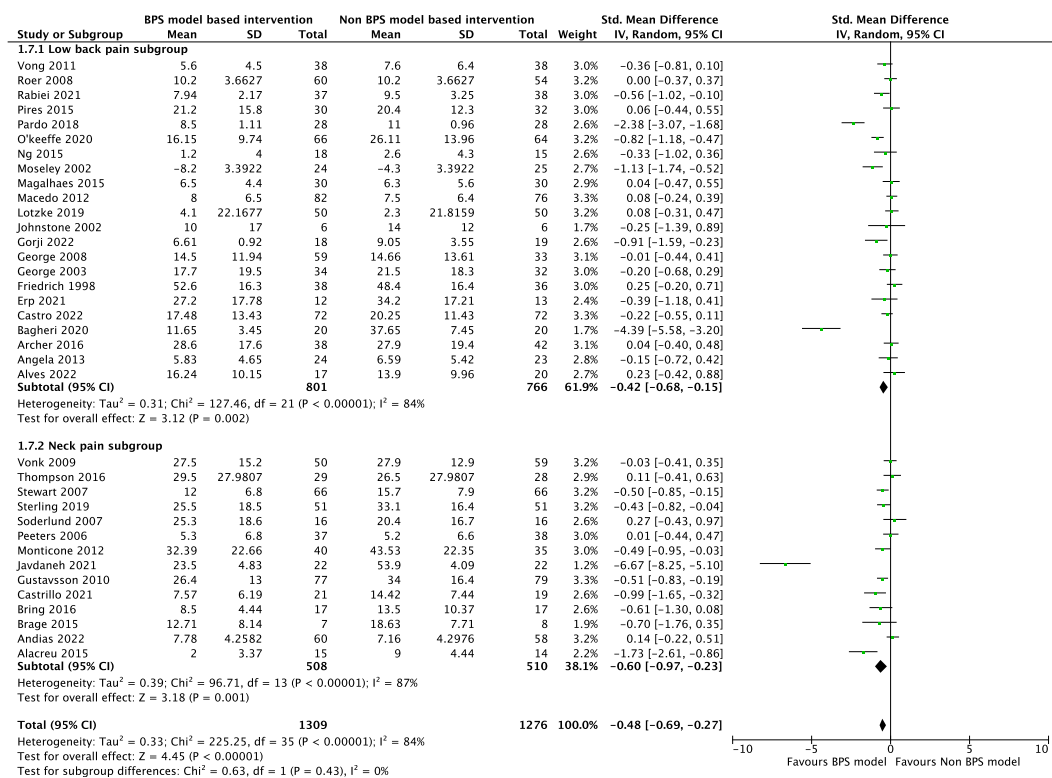


Figure 5. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on disability in the short term.

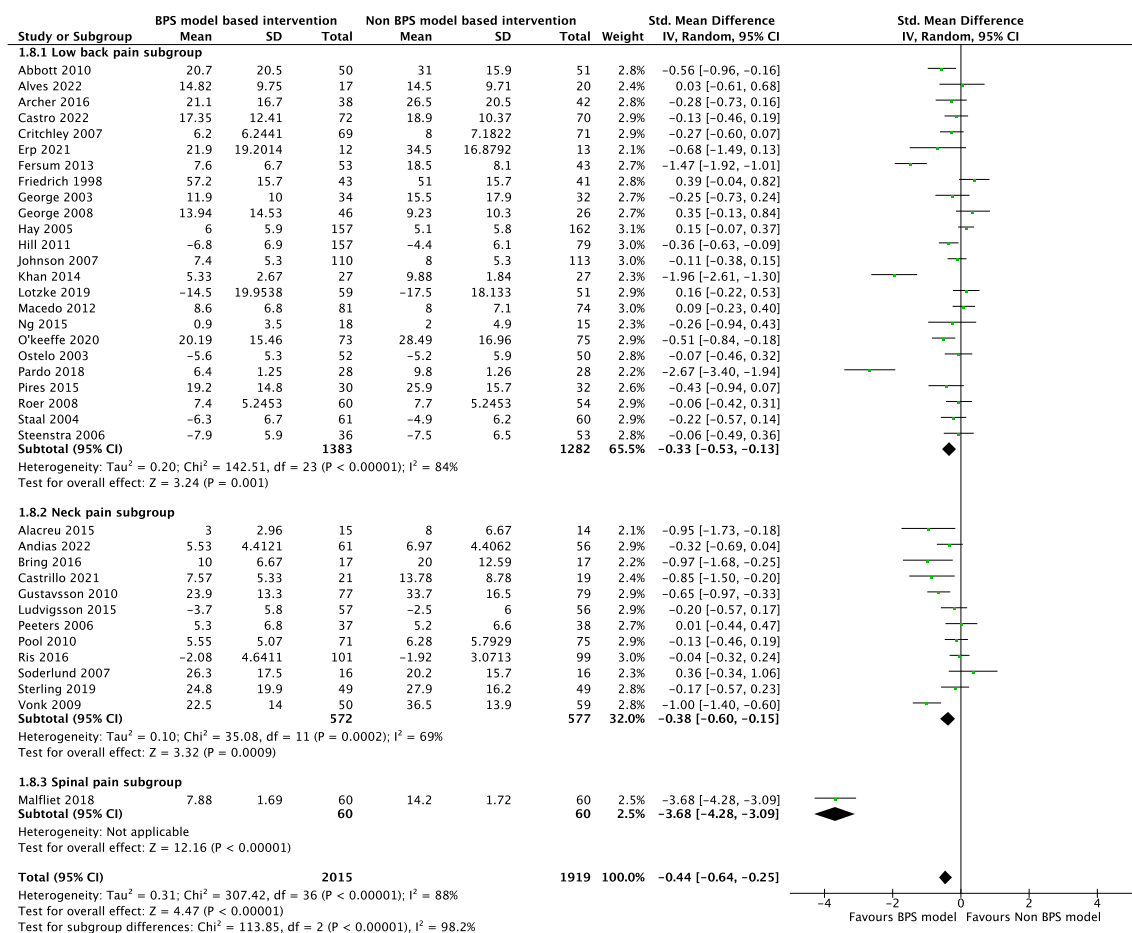


Figure 6. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on disability in the medium term.

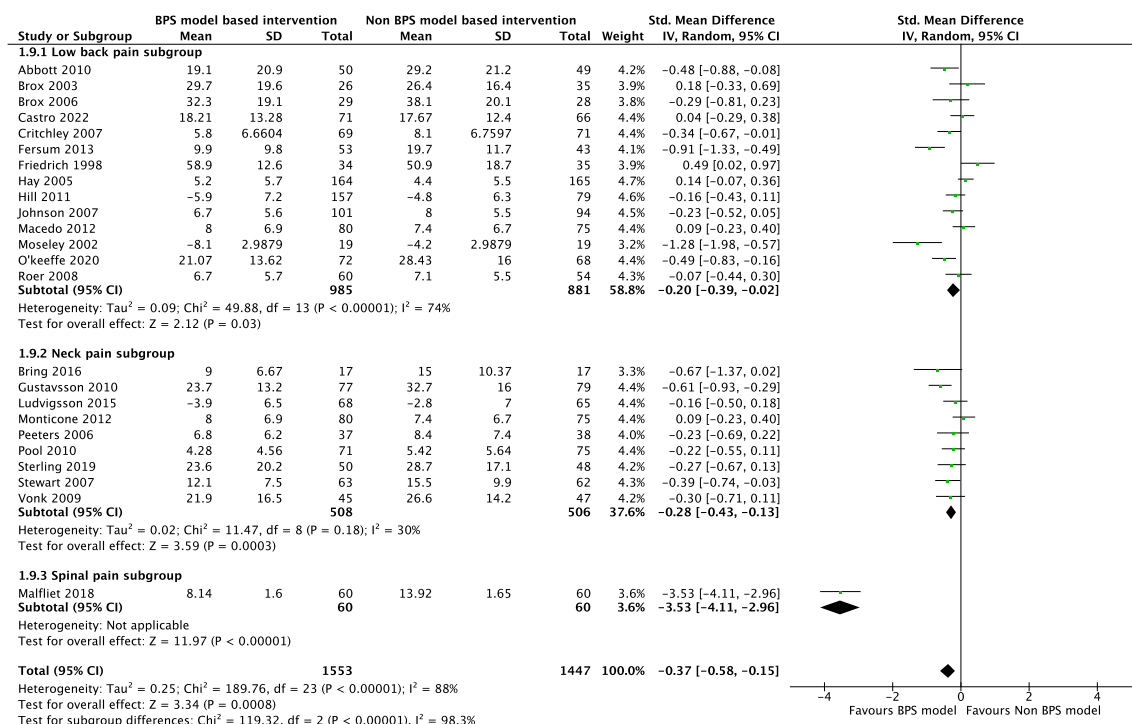


Figure 7. Detailed forest plots of the effect for the BPS model of intervention by physiotherapist: relative to the non-BPS model of intervention on disability in the long term.

Discussion

This systematic review examined the effects of a physical therapist-led BPS model-based intervention for spinal disorders. The existing evidence supported the view that physical therapist-led interventions based on the BPS model were more effective than non-BPS model-based interventions in improving pain and disability. Overall, the evidence supporting the certainty of the primary outcome was low.

Improvement in pain was one of the primary outcomes, and there was low evidence supporting its certainty, regardless of its duration or the region affected. A statistically significant effect was reported in the intervention groups for spinal and neck disorders regardless of the duration, with particularly large effect sizes for the neck pain group. In a previous systematic review of similar themes, the neck pain group was not significantly effective in the short or long term [98]. Furthermore, a systematic review of the effectiveness of multidisciplinary

biopsychological rehabilitation, which included interventions by non-physical therapists, also found no significant effects in the neck pain group[99]. On the other hand, we found considerable evidence supporting the effectiveness of a physical therapist-led intervention based on the BPS model for neck pain. Regarding the LBP group, the current study did not result in significant medium- and long-term effects. The previous studies based on the physical therapist-led BPS model-based interventions also reported that these interventions did not yield significant effects[98]. However, the multidisciplinary BPS rehabilitation for chronic LBP reported significant effects in the short and medium-term, although heterogeneity was high[100].

In terms of disability, there were statistically and clinically significant effects for all spinal and neck disorders durations. The results were also significant for the LBP group, but not significantly different when sensitivity analysis was performed for the short- and long-term effects. Also, the clinical significance was not found for the LBP group. The study suggested that the BPS model-based physical therapist-led interventions can improve the disability in spinal disorders including neck pain group although the quality of evidence was low. Among the individual studies, the three with high effect sizes reported interventions that combined pain neuroscience education (PNE) and exercise therapy [62, 66, 97]. This may be a good fit for exercise therapy and PNE within the framework of the BPS model. A similar previous review examining these interventions reported no significant differences in the neck pain or LBP groups[98]. The difference in the results of the previous and current review may be attributed to the numerous RCTs published ever since. Also, the intervention methods have become more BPS model-based and multifaceted with higher quality RCTs.

In addition, this review included a subgroup-analysis of the studies that administered additional training of the BPS model. The results showed that the subgroup receiving training about the BPS model before the intervention did not have a more significant effect size. The

findings of this study may suggest that prior training may not necessarily yield significant benefits.

Implications for clinical practice

The results suggest that physical therapist-led interventions based on the BPS model may potentially improve disability and pain intensity for spinal disorders for the long term. On the other hand, improvements in psychological factors were limited, and the level of evidence was low. There was also a lack of benefit from the pre-intervention training of the BPS model, deeming the effectiveness of prior training uncertain. However, we did not include a qualitative assessment of the prior intervention methods in this review. Future endeavors may aim at standardizing and improving the quality of training methods for understanding the BPS model to improve the quality of interventions based on it, ensuring greater effectiveness.

Limitations

This was a large-scale systematic review involving 57 RCTs in spinal disorders on the effects of interventions based on the BPS model which has become a current practice standard in physical therapy. However, we observed that there was a lack of standardization in the methods and interventions. For example, interventions based on the BPS model were difficult to define accurately. This study only defined physical therapists as using both psychosocial and physical approaches. Therefore, a wide range of interventions were observed in the included studies. The control group also had no restrictions. This could be the reason for the high heterogeneity overall. In addition, the levels of certainty for each pooled analysis in this study were low overall. In particular, primary outcomes were mostly low, which is one limitation of this study. This could be because the inconsistency was very serious in most of the pooled results. Furthermore, the inclusion of only English language articles and the limitation to published

studies create a publication bias. Future reviews need to consider including published and unpublished studies written in languages other than English, although the quality of such studies must be carefully monitored.

Conclusion

This systematic review suggests that physical therapist-led interventions based on the BPS model effectively improve disability and reduce pain intensity in spinal disorders. However, the evidence supporting the certainty of the outcome was low overall. Further studies must examine the effects of a rigorous definition of interventions and high-quality interventions in the BPS model.

Chapter 3.

Factors associating with disability of non-specific low back pain in different subgroups

Objective

This study explored which factors influenced disability of acute and non-acute phases of NSLBP. The study hypothesis was that factors associated with disability would change depending on the duration of the illness. The hypothesis extended to propose that psychological factors would play a critical role, with their influence changing as NSLBP progresses from acute to non-acute stages.

Material and methods

Participants

Participants were collected from the two medical institutions from January 2019 to December 2020. Written informed consent was obtained from the patients before the study. The study was conducted in compliance with the Declaration of Helsinki and was conducted with the approval of the Ethics Committee of Sapporo Maruyama Orthopaedic Hospital (approved number: 0039) and the Faculty of Health Sciences, Hokkaido University (approved number: 20–58). The inclusion criteria of the participants were as follows: (1) over 20 years old; (2) diagnosed as NSLBP by an orthopaedic surgeon, with pain occurring in the lumbosacral region with radiation limited above the knee, with or without referred pain and signs of nerve root compromise; (3) no use of painkillers at the initial physiotherapy session; (4) being able to understand the Japanese language well enough to complete the questionnaires independently. The following exclusion criteria were included: (1) presence of spinal deformities; (2) any history of surgery on the spine; (3) pregnancy; (4) rheumatological and inflammatory disease; and (5) other serious pathologies (e.g., pyogenic spondylitis and cauda equina syndrome). Participants were

divided into two groups: the acute NSLBP group with an onset of fewer than eight weeks (56 days) and the non-acute NSLBP group with more than 57 days.

Procedures

This cross-sectional study compared two subgroups of NSLBP at two hospitals was performed according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement [101]. We collected data on age, sex, height, weight, medical diagnosis and duration of symptoms from medical records. Furthermore, we collected data on pain intensity, disability and psychosocial factors by patient-reported outcome measures (PROMs). For all participants, the following PROMs were evaluated immediately before the initial physiotherapy session: (1) an 11-point numerical rating scale (NRS) for pain intensity [102, 103]; (2) Roland Morris Disability Questionnaire (RMDQ) for disability due to LBP; (3) Pain Catastrophising Scale (PCS) for pain catastrophising [104]; (4) Tampa Scale for Kinesiophobia (TSK) for fear of movement [105]; and (5) Pain Self-Efficacy Questionnaire (PSEQ) for pain self-efficacy [106].

Measurement

Pain intensity

NRS was used for pain intensity. The 11-point NRS was used to measure pain intensity [102, 103] to determine average pain intensity on the evaluation day. A score of 0 indicates no pain, and a score of 10 indicates the worst imaginable pain. Alghadir et al. assessed knee pain intensity with multiple scales, including the NRS, and demonstrated that NRS was valid [107].

Disability / functional status

The Japanese version of the RMDQ, which contains 24 dichotomous scales (No = 0; Yes = 1), was used. A higher total score indicates more significant functional impairment due to LBP. Concurrent validity of the Japanese RMDQ, high internal consistency (Cronbach's alpha for all

items = 0.86) and high test-retest reliability (0.95) have been clarified [108].

Pain catastrophising

To assess pain catastrophising, the Japanese version of the PCS, consisting of 13 items from 0 to 4, was used [109]. The total score is 52, with a higher total score indicating more significant deficits of pain catastrophising. 30 is the cut-off point for a clinically relevant level of catastrophising. The construct validity and high internal consistency of the Japanese version of the PCS (Cronbach alpha for all items = 0.89) were shown [110].

Fear of movement

The Japanese version of the TSK, consisting of 17 items from 1 to 4 and a total score of 68, was used. A higher total score indicates strong fear of movement. 37 is the cut-off point for it [111]. The concurrent validity and high internal consistency of the Japanese version of the TSK (Cronbach alpha for all items = 0.85) have been confirmed [111].

Pain self-efficacy

The Japanese version of PSEQ, consisting of 10 items from 0 to 6, was used for pain self-efficacy [112]. A high total score indicates stronger self-efficacy for pain. The concurrent validity and high internal consistency of the Japanese version of the PSEQ (Cronbach alpha for all items are more than 0.50) have been confirmed [112]. There is no cut-off value.

Data analysis

We excluded subjects with missing data in the demographic characteristics and measures (n=25). The differences were compared between the acute NSLBP and non-acute NSLBP groups using the Welch's test. The association between disability and other factors was examined for each group using Pearson's product-moment correlation coefficient. For this study, r-values of ≤ 0.40 , 0.40 - 0.75 and ≥ 0.75 were considered to indicate weak or no correlation, moderate correlation

and strong correlation, respectively [113]. Furthermore, a hierarchical multiple regression analysis was performed to analyse factors associating with disability for the acute and non-acute groups, respectively. The object (dependent) variable included the RMDQ for disability, and the explanatory (independent) variables included the characteristics of the participants, pain intensity and psychological factors (PCS, TSK and PESQ). Demographic characteristics including age, body weight and BMI were first entered (step 1) as control variables, followed by pain intensity in the second step (step 2). Finally, the psychological factors, including the scores of PCS, TSK and PESQ, were added in the third step (step 3) to test unique associations between the psychological factors and patients' disability beyond the effects of patients' demographic characteristics and pain intensity. HAD ver. 16.1 (Hiroshi Shimizu, Nishinomiya, Japan) was used to perform all statistical analyses [114]. All p-values are two-sided. The alpha level was set at 5%.

Results

Demographic data

The total number of participants was 235 (124 participants of the acute NSLBP group and 111 participants of the NSLBP non-acute group) from two facilities. There was no significant difference in the participants' demographic characteristics between the two facilities. Tables 1 shows the participants' demographic characteristics for each group.

Comparison of intergroup pain intensity, disability and psychosocial factors

Table 2 presents pain intensity, disability and psychosocial factors between the acute and non-acute groups. There was no significant difference between the two groups.

Table 1. Characteristics of the participants

Patients	Acute NSLBP (n=124)	Non-acute NSLBP (n=111)
Age (<i>years</i>), mean (SD)	54.56 (15.20)	58.26 (15.81)
Gender (<i>n of men</i>), (%)	51 (41.1)	43 (38.7)
Height (cm), mean (SD)	162.28 (8.97)	159.32 (8.04)
Weight (kg), mean (SD)	63.15 (12.43)	60.89 (11.41)
Body mass index	23.87 (3.79)	23.92 (3.82)
Pain intensity over Low Back (<i>0-10</i>), mean (SD)	3.90 (2.30)	4.23 (2.08)
Roland-Morris Disability Questionnaire (<i>0-24</i>), mean (SD)	4.97 (4.15)	5.60 (4.45)
Pain Catastrophizing Scale (<i>0-52</i>), mean (SD)	20.92 (9.79)	22.18 (10.08)
Tampa Scale for Kinesiophobia (<i>17-68</i>), mean (SD)	35.83 (5.91)	36.01 (7.21)
Pain Self-Efficacy Questionnaire (<i>0-60</i>), mean (SD)	39.87 (11.65)	41.55 (10.90)

Table 2. Comparison of intergroup pain intensity, disability and psychosocial factors

Patients	Acute NSLBP (n=124)	Non-acute NSLBP (n=111)	P-value	95% Confidence interval
Pain intensity over the low back (0-10), mean (SD)	3.90 (2.31)	4.23 (2.08)	0.23	−0.22 to 0.90
Roland-Morris Disability Questionnaire (0-24), mean (SD)	4.97 (4.15)	5.60 (4.45)	0.26	−0.48 to 1.75
Pain Catastrophizing Scale (0-52), mean (SD)	20.93 (9.79)	22.18(10.08)	0.33	−1.30 to 3.81
Tampa Scale for Kinesiophobia (17-68), mean (SD)	35.83 (5.91)	36.02 (7.21)	0.82	−1.52 to 1.90
Pain Self-efficacy Questionnaire (0-60), mean (SD)	39.87(11.65)	41.55 (10.90)	0.25	−1.22 to 4.58

Correlation of disability, pain intensity and psychological factors

Table 3 shows a matrix of the correlations for the acute NSLBP and non-acute NSLBP groups. Positive indicates a positive correlation, and negative indicates a negative correlation. Moderately significant correlations were found between RDQ and PSEQ ($r = -0.409$) and between TSK and PCS ($r = 0.439$) of the acute NSLBP group. Only RDQ and PSEQ ($r = -0.520$) had a moderate or significant correlation of the non-acute NSLBP group.

Table 3. A matrix of the correlations

	1	2	3	4	5	6	7
Acute NSLBP group (n=124)							
1.Age	1.00						
2.BMI	-0.04	1.00					
3.LBP	0.01	-0.04	1.00				
4.PCS	-0.07	-0.05	0.06	1.00			
5.TSK	-0.03	0.17	0.04	-0.44**	1.00		
6.PSEQ	0.03	-0.01	0.03	-0.31**	-0.34**	1.00	
7.RDQ	-0.01	0.02	0.27**	0.32**	0.21**	-0.41**	1.00
Non-acute NSLBP group (n=111)							
1.Age	1.00						
2.BMI	0.13	1.00					
3.LBP	0.07	-0.01	1.00				
4.PCS	-0.03	0.14	0.36**	1.00			
5.TSK	0.17	0.04	0.10	0.31**	1.00		
6.PSEQ	-0.20*	0.04	-0.15	-0.23*	-0.23*	1.00	
7.RDQ	0.16	0.09	0.28**	0.38**	0.33**	-0.52**	1.00

*p<0.05, **p<0.01,

NSLBP: Non-Specific Low Back Pain; LBP: Low Back Pain; BMI: Body Mass Index; PCS: Pain Catastrophizing Scale; TSK: Tampa Scale for Kinesiophobia; PESQ: Pain Self Efficacy Questionnaire; RMDQ: Roland Morris Disability Questionnaire

Hierarchical multiple regression analysis

Tables 4 and 5 show the hierarchical multiple regression analysis results for the acute NSLBP and non-acute NSLBP groups.

Acute NSLBP group

The acute NSLBP group consisted of 124 participants. Table 4 presents the results. In step 1, the demographic variables were added. The hierarchical linear regression results showed that patients' demographic factors, tested in step 1 explained 0.0% of the variance in disability. There was no significant association between all demographic factors and worse disability. In step 2, we included pain intensity as the independent variable. The results showed that the pain intensity, tested in step 2, explained an additional 7.7% of the variance in disability. There was a significant association between pain intensity and worse disability ($\beta = 0.282$; $p < 0.01$). In step 3, psychological factors, which were TSK, PCS and PESQ, were included as the independent variables. The results of hierarchical linear regression showed that psychological factors, tested in step 3, explained an additional 20.7% of the variance in disability. Finally, those significant relations to disability were PSEQ ($\beta = -0.361$; $p < 0.01$), LBP ($\beta = 0.280$; $p < 0.01$) and PCS ($\beta = 0.209$; $p < 0.05$). This final model explained 28.4% of the variance in disability of participants.

Non-acute NSLBP group

The non-acute NSLBP group consisted of 111 participants. Table 5 presents the results. In step 1, the demographic variables were added. The results showed that patients' demographic factors, tested in step 1, explained 1.3% of the variance in disability. All demographic factors were not statistically significant. In step 2, pain intensity was included as a variable. The results of

hierarchical linear regression showed that the pain intensity, tested in step 2, explained an

Table 4. Results of hierarchical linear regression analysis for acute NSLBP group

Dependent variables: Disability			
	Step 1 (β)	Step 2 (β)	Step 3(β)
Gender	0.00	-0.05	-0.41
Age	-0.01	-0.01	0.02
BMI	0.02	0.02	0.03
LBP		0.28**	0.28**
PCS			0.21**
TSK			-0.04
PSEQ			-0.36**
R ²	0.00	0.08	0.28
ΔR^2	0.00	0.08	0.21

* $p < .05$, ** $p < .01$,

B: Standardized Coefficients; NSLBP: Non-Specific Low Back Pain; LBP: Low Back Pain; BMI: Body Mass Index; PCS: Pain Catastrophizing Scale; TSK: Tampa Scale for Kinesiophobia; PESQ: Pain Self Efficacy Questionnaire; RMDQ: Roland Morris Disability Questionnaire; R²: the proportion of explained variance in dependent variable by the model; ΔR^2 the change in R² values from one model to another

additional 8.2% of the variance in disability. There was a significant association between pain intensity and worse disability ($\beta = 0.288$; $p < 0.01$). In step 3, psychological factors, which are TSK, PCS and PSEQ, were included. The results of hierarchical linear regression showed that psychological factors, tested in step 3, explained an additional 27.4% of the variance in disability. Ultimately, PSEQ was significantly related to disability ($\beta = -0.416$; $p < 0.01$). This final model explained 39.3% of the of the variance in disability of participants.

Table 5. Results of hierarchical linear regression analysis for non-acute NSLBP group (n = 111)

	Dependent variable: Disability		
	Step 1 (β)	Step 2 (β)	Step 3(β)
Gender	0.08	0.07	0.07
Age	-0.14	0.16	0.05
BMI	0.08	0.08	0.08
LBP		0.29**	0.14
PCS			0.17
TSK			-0.16
PSEQ			-0.42**
R ²	0.13	0.12	0.39
ΔR^2	0.13	0.08	0.27

*p< 0.05, **p< 0.01,

β : Standardized Coefficients; NSLBP: Non-Specific Low Back Pain; LBP: Low Back Pain; BMI: Body Mass Index; PCS: Pain Catastrophizing Scale; TSK: Tampa Scale for Kinesiophobia; PESQ: Pain Self Efficacy Questionnaire; RMDQ: Roland Morris Disability Questionnaire; R²: the proportion of explained variance in dependent variable by the model; ΔR^2 : the change in R² values from one model to another

Discussion

This study investigated factors associated with disability through hierarchical multiple regression analysis of acute and non-acute NSLBP. Overall, pain intensity and psychosocial factors, the explanatory power increased. Pain self-efficacy had a significant effect in the acute and non-acute groups. From the results, the pain self-efficacy might be the critical factor associating with disability in patients with NSLBP.

For the acute NSLBP group, pain self-efficacy had the most significant association with disability. Several other studies showed the relationship between self-efficacy and disability. A study on spine disorders, including NSLBP patients, found that low self-efficacy significantly influenced disability of LBP and may also affect postoperative outcomes [115]. In a study on LBP subjects in Italy, more than half of the patients had low self-efficacy, and the group had a high level of disability [116]. It has been reported that pain self-efficacy is a more critical factor for disability than fear of movement [117]. Additionally, among fear of movement, disability and pain intensity, pain self-efficacy serves as a mediator [118]. Self-efficacy was also reported to affect functional aspects such as postural stability and range of motion at the spine; the higher the self-efficacy, the greater the stability and range of motion [22]. Based on the results of this study, it is expected that pain self-efficacy is strong association with disability. Furthermore, the significant association between self-efficacy and disability of the acute phase is one of the new findings as most of the previous studies have focused on non-acute NSLBP. Indeed, pain self-efficacy has been reported to be more critical in the recovery of LBP than other psychosocial factors, but these participants were only for the non-acute NSLBP [119, 120]. The important aspect of managing NSLBP is to take appropriate action in the acute phase and prevent it from becoming chronic. However, low pain self-efficacy may lead to a vicious cycle, as typified by the fear-avoidance model, leading to chronicity. The fear-avoidance model is a model that describes how persistent musculoskeletal pain is caused and maintained as a result of fear-based attentional processes and avoidance behaviors [121]. Thus, pain self-efficacy may

be a key aspect in implementing the management of NSLBP for preventing chronicity. However, one reason for the solid association between pain self-efficacy and disability may be that the PSEQ questions overlap with some disability items. For example, considering "I stay in bed most of the time because of my back." for RDQ and "I can gradually become more active, despite the pain." for PESQ, the difference between these two scales is just their response directions. Therefore, it is important to remember that it should be considered if there is a significant association.

In addition, pain intensity was indicated to be another related factor of disability for the acute phase. From previous studies, severe pain intensity is a factor in the transition from the acute to the chronic phase [8], so improving pain intensity in the acute phase might be another key to managing chronicity. Pain self-efficacy was also associated with disability of the non-acute phase. Previous studies have reported that many psychological factors can influence non-acute NSLBP. Ogunlana et al. showed that those with higher PCS values have a more severe disability [122]. Wertli et al. showed that catastrophising was a prognostic factor for LBP [23]. However, it has also been shown that the mechanism is still unclear. Besides catastrophic thoughts of pain, Leeuw et al. reported an association between pain-related fear and functional impairment for non-acute NSLBP patients [123]. Wertli et al. found an association between fear-avoidance beliefs and disability developed within six months, which is one crucial factor for chronicity [124]. These factors are also predictors of chronicity of NSLBP [125, 126]. Based on the results of previous studies, it is highly likely that many psychosocial factors were related to disability for non-acute NSLBP. The results of this study suggest that pain self-efficacy may be a more relevant factor with disability.

Limitations

One limitation of our study was the lack of clarity as to whether the participants of the acute group were truly acute in the first episode or just a recent exacerbation of a chronic problem.

The duration of the disease was confirmed by interviewing the participants in this study. We did not include a question on whether it was the first time or a recurrence. Therefore, this may have overlooked the possibility that the acute group included patients with recurrence NSLBP. Second, the recruitment of participants may have been somewhat biased, with only two facilities. If we could have recruited participants from more than two facilities, the data would have been more reliable. However, since there was no difference in the participants' characteristics between the two facilities, we believe that the sample is reliable. Third, the biopsychosocial variables were limited. Although this study selected factors that influence disability for NSLBP based on previous studies, the data might have been more attractive if other psychosocial factors such as depression and anxiety had been included. Finally, it should be noted that some of the PSEQ items and items of RDQ are overlapped.

Clinical implications and future research

Despite the small sample size and the cross-sectional study design with no interventions, this study revealed that pain self-efficacy is one of the most critical factors associating with disability of NSLBP. It may be helpful to examine a larger sample size and investigate the association between other psychological or social factors and disability in the future.

Conclusion

The results suggest that the factors associating with disability differed depending on the duration of the disease, and pain self-efficacy was significantly associated with disability of NSLBP. In the future, it may be possible to investigate the association between disability and more multifaceted factors, including other psychosocial factors, to clarify the disability-related aspects of NSLBP.

Chapter 4.

Prediction of postoperative disability in patients with degenerative diseases of the lumbar spine using preoperative psychological factors

Objective

The degenerative lumbar spinal disease has become a significant global problem in recent years, and surgery has been performed in severe cases. In most cases, surgery improves pain, disability, and quality of life (QoL). However, in some cases where the procedure has been considered anatomically successful, the patients had residual disabilities and could not return to work [127, 128]. This study aimed to examine factors that predict disability in patients more than 1 year after surgery from a multidimensional perspective that includes a wider variety of psychological factors. It was hypothesized that beyond the success of the surgery itself, factors such as the patient's psychological factors, feelings about the pain, and how they cope with challenges may play a significant role in recovery.

Materials and Methods

Study design

This was a retrospective longitudinal study. This study was performed according to the tenets of the Declaration of Helsinki and written informed consent was obtained from all the participants. This study was approved by the appropriate ethics committee and has been reported according to the STROBE guidelines.

Participants

The study participants were recruited from our institution between October, 2017 and September, 2019. The inclusion criteria were as follows: (1) age between 20 and 90 years; (2) diagnosis of either degenerative stenosis or herniated disc, and having undergone surgery, and

(3) ability to understand the Japanese language well enough to complete the questionnaires independently. The exclusion criteria were as follows: (1) any history of surgery of the spine, (2) pregnancy, (3) rheumatological and inflammatory disease, and (4) other serious pathologies (e.g., pyogenic spondylitis and cauda equina syndrome).

Procedures

Data on age, sex, height, weight, and medical diagnosis were collected from the medical records. The day before surgery, data on pain intensity, disability, and psychosocial factors were collected using PROM. Pain intensity and disability were assessed by mail in October 2020 for the same participants more than one year after surgery.

Measurement outcomes

Pain intensity

An 11-point numerical rating scale (NRS) was used to measure pain intensity to determine the average pain intensity on the day of evaluation [102]. Both low back pain and leg pain were assessed using the NRS.

Disability

The Japanese version of the RMDQ was used to measure disability[108]. The RMDQ is a reliable measure for low back pain outcomes, widely used globally alongside the ODI [129]. It was reported that the RMDQ had a lower proportion of incomplete or ambiguous responses than the ODI questionnaire [130]. The RMDQ contains 24 dichotomous scales (no = 0; yes = 1), and a higher total score indicates more significant functional impairment due to LBP. The Japanese version of the RMDQ has been reported to have high internal consistency (Cronbach's alpha for all items = 0.86) and test-retest reliability (0.95) [108].

QOL

The EuroQol-5 Dimensions-5 Levels (EQ-5D-5L) questionnaire was used to assess the participants' quality of life [131]. The EQ-5D-5L is a widely used, standardized instrument that measures health-related quality of life, covering five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has five response levels ranging from no problems to extreme problems. The responses can be converted into a single index value, representing the participant's overall health state.

Fear of movement

The Japanese version of the Tampa Scale for Kinesiophobia (TSK) was used [111]. TSK is one of the most frequently employed measures for assessing pain-related fear in back pain patients, and is a reliable tool for assessing the fear of movement and is among the most translated and utilized instruments worldwide, including in Japan [111, 132, 133]. The TSK consists of 17 items ranging from 1 to 4, with a total score of 68. The higher the total score, the stronger the fear of movement. The TSK has been reported to have concurrent validity and high internal consistency (Cronbach alpha = 0.85 for all items)[111].

Pain catastrophizing

The Japanese version of the Pain catastrophizing scale (PCS) was used to assess pain catastrophizing [110]. The PCS was selected to assess pain catastrophizing, as it is a widely used and validated measure for this psychological construct [134]. It consists of 13 items ranging from 0 to 4, with a total score of 52 and a higher total score indicating more significant deficits in pain catastrophizing. The PCS has demonstrated strong construct validity and high internal consistency in its Japanese version, indicating its suitability for the current study population [110]. The construct validity and high internal consistency of the Japanese version of PCS (Cronbach's alpha for all items=0.89) have also been reported [110].

Anxiety and depression

We used the Japanese version of the Hospital Anxiety and Depression Scale (HADS) [135]. The HADS was chosen to assess anxiety and depression in the study population as it is a well-established and widely used instrument for detecting these psychological states in hospital settings [136]. The HADS has been specifically designed for patients with physical illnesses, and its construct validity has been confirmed in numerous studies, making it an appropriate choice for our study [137]. The HADS consists of 14 items, with odd-numbered items related to depression (HADS-D) and even-numbered items related to anxiety (HADS-A) scored on a scale from 0 to 3. The higher the total score, the more severe the anxiety and depression. The construct validity of the HADS has been confirmed [135, 138].

Statistical analysis

Before conducting any statistical analyses, the normality of the data distribution was assessed using the Shapiro-Wilk test. Descriptive analyses were conducted to understand the participants' characteristics. Missing values were imputed using the hot-deck method. Comparisons of postoperative and preoperative outcomes were conducted with a paired t-test, or if necessary, non-parametric tests such as the Wilcoxon signed-rank test were employed. The patients were divided into age subgroups: less than 40, 40–49, 50–59, 60–69, 70–79, and more than 80 years old. The outcome measures include NRS for LBP and leg pain, the RMDQ, and the EQ-5D-5L. Hierarchical multiple regression analysis was used to analyze the preoperative factors associated with the degree of disability in participants more than 1 year after lumbar surgery. The dependent variable was the RMDQ score postoperatively. The independent variables were the preoperative RMDQ scores in step 1, participant's characteristics (age and sex) and NRS in step 2; and PCS, TSK, HADS-A, and HADS-D in step 3. The interaction with the other variables was step 4. The variance inflation factor (VIF) was applied to diagnose possible multicollinearity among all explanatory variables, with $VIF < 5$ indicating no significant multicollinearity. The explanatory variables were centered on all hierarchical multiple

regression analyses to avoid multicollinearity. In addition, simple slope analysis was performed when the interaction was statistically significant. A simple slope test was used to evaluate the effect of the interaction by substituting the values obtained by adding and subtracting one standard deviation (SD) of the variables with which there was an interaction [139]. HAD ver. 16.1 (Hiroshi Shimizu, Nishinomiya, Japan) was used to perform all statistical analyses [114]. All p-values were two-sided. The alpha level was set at 5 %.

Results

Participant characteristics

The total number of participants included in this study was 176. Table 6 was summarized the preoperative data of the study participants, including demographic information, pain measures and psychological factors. The mean age was 64.2 years and 51.7% of the participants were male. The participants' diagnoses were split between lumbar canal stenosis (76.7%) and lumbar disc herniation (23.3%). Three types of surgery were performed: fusion (56.8%), laminoplasty (25.6%), and discectomy (17.6%). Several pain and disability assessment tools were used in the study. These included the NRS for LBP and leg pain, and the RMDQ. The mean scores for low back pain and leg pain were 4.42 and 5.74, respectively. The mean RMDQ score, which assesses disability related to low back pain, was 10.97. These preoperative data provide a baseline understanding of the study population and a basis for comparison of preoperative and postoperative outcomes. Details of the participants' characteristics are shown in Table 6.

Table 6. Baseline demographic and clinical characteristics of study population (n = 176)

Variables	Total (n = 176)	Group of age					
		Less than 40 (n=14)	40-49 (n=17)	50-59 (n=24)	60-69 (n=48)	70-79 (n=54)	More than 80 (n=19)
Age (year), mean (SD)	64.15 (14.45)	32.51 (5.10)	35.05 (2.77)	55.91 (2.70)	64.8 (3.26)	75.04 (2.59)	82.85 (2.56)
Gender (n of men), (%)	91 (51.70)	6 (42.85)	11 (64.70)	11 (45.83)	31 (64.58)	16 (29.62)	10 (52.63)
BMI, mean (SD)	25.29 (15.81)	23.96 (6.20)	25.76 (4.40)	25.09 (3.93)	28.49 (29.73)	23.55 (4.02)	23.49 (3.35)
Diabetes (n of yes), (%)	25 (14.23)	1 (7.14)	1 (5.88)	3 (12.50)	10 (20.80)	6 (11.11)	4 (21.05)
Hypertension (n of yes), (%)	75 (42.61)	1 (7.14)	2 (11.76)	9 (37.50)	23 (47.92)	28 (51.90)	12 (63.16)
Diagnosis (n), (%)							
Lumbar canal stenosis	135 (76.71)	1 (7.14)	4 (23.57)	20 (83.33)	38 (79.17)	51 (94.44)	17 (89.47)
Lumbar disk herniation	41 (23.30)	13 (92.86)	13 (76.47)	4 (16.67)	10 (20.83)	4 (7.41)	2 (10.53)
Type of Surgery (n), (%)							
Fusion	103 (56.81)	3 (21.43)	6 (35.29)	13 (54.17)	28 (58.33)	42 (77.78)	11 (57.89)
Laminoplasty	42 (25.60)	1 (7.14)	0 (0.00)	7 (29.17)	17 (35.42)	10 (18.52)	7 (36.84)
Discectomy	31 (17.61)	10 (71.43)	11 (64.71)	4 (16.67)	3 (6.25)	2 (3.70)	1 (5.26)
Level operated (n), (%)							
L1/2	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
L2/3	5 (2.84)	0 (0.00)	0 (0.00)	1 (4.17)	2 (4.17)	1 (1.85)	1 (5.26)
L3/4	13 (7.39)	0 (0.00)	1 (5.88)	1 (4.17)	4 (8.33)	6 (11.11)	1 (5.26)
L4/5	65 (36.93)	3 (21.43)	9 (52.94)	12 (50.0)	17 (35.42)	16 (29.63)	8 (42.11)
L5/s1	26 (14.77)	8 (57.14)	5 (29.41)	3 (12.5)	3 (6.25)	5 (9.26)	2 (10.53)
≥2 levels	67 (38.07)	3 (21.43)	2 (11.76)	7 (29.17)	22 (45.83)	26 (48.15)	7 (36.84)
NRS for LBP (0–10), mean (SD)	4.42 (2.60)	3.71 (2.21)	3.0 (2.89)	3.66 (2.57)	4.06 (2.36)	5.37 (2.25)	5.57 (2.44)
NRS for leg pain (0–10), mean (SD)	5.74 (2.68)	5.42 (1.76)	5.23 (3.35)	5.6 (2.99)	5.65 (2.46)	5.91 (2.51)	6.23 (3.01)
RMDQ (0–24), mean (SD)	10.97 (6.10)	12.71 (5.70)	12.05 (6.69)	10.12 (5.91)	9.93 (5.58)	10.71 (6.46)	13.38 (5.14)
EQ-5D-5L (0-1), mean (SD)	0.55 (0.17)	0.57 (0.09)	0.53 (0.23)	0.59 (0.09)	0.60 (0.17)	0.52 (0.17)	0.49 (0.19)
TSK (17–68), mean (SD)	38.85 (9.87)	41.13 (5.96)	41.29 (6.34)	39.83 (9.83)	39.74 (7.91)	37.64 (9.84)	35.38 (12.49)
PCS (0–52), mean (SD)	26.83 (12.58)	30.36 (11.21)	24.23 (10.74)	26.33 (12.93)	24.91 (10.51)	30.46 (12.61)	25.38 (14.47)
HADS-A (0–21), mean (SD)	5.22 (3.68)	6.92 (3.54)	5.71 (2.76)	4.79 (3.61)	4.78 (3.38)	5.28 (4.34)	4.81 (3.49)
HADS-D (0–21), mean (SD)	4.99 (3.49)	6.07 (3.43)	5.52 (3.69)	4.5 (2.56)	4.61 (3.81)	5.11 (3.71)	5.14 (3.28)

Notes: BMI, Body mass index; NRS, Numerical Rating Scale; LBP, low back pain; RMDQ, Roland-Morris Disability Questionnaire; EQ-5D-5L, EuroQol-5 Dimensions-5 Levels; TSK, Tampa Scale for Kinesiophobia; PCS, Pain Catastrophizing Scale; HADS-A, Hospital Anxiety and Depression Scale for anxiety; HADS-D, Hospital Anxiety and Depression Scale for depression.

Postoperative outcomes

Table 7 shows the mean pre- and post-operative scores as well as the changes for the different outcome measures. The mean NRS for LBP showed significant improvement from preoperative to postoperative scores across all age subgroups, with the overall mean change being -2.40 ($p < 0.01$). The greatest improvement was observed in the more than 80 age group, with a mean change of -3.52 ($p < 0.01$). Similarly, the mean NRS for leg pain significantly improved from preoperative to postoperative scores in all age subgroups, with the overall mean change being -3.98 ($p < 0.01$). The less than 40 age group showed the greatest improvement, with a mean change of -5.00 ($p < 0.01$).

The RMDQ scores also improved significantly across all age subgroups, with the overall mean change being -6.40 ($p < 0.01$). The greatest improvement was observed in the less than 40 age group, with a mean change of -10.64 ($p < 0.01$). In terms of the EQ-5D-5L scores, there was a significant improvement from preoperative to postoperative scores across all age subgroups, with the overall mean change being 0.21 ($p < 0.01$). The 40–49 age group demonstrated the greatest improvement, with a mean change of 0.36 ($p < 0.01$). In summary, the data show significant improvements in pain, disability, and quality of life measures following surgery for degenerative diseases of the lumbar spine across all age subgroups, with varying degrees of improvement observed in different age groups.

Table 7. Comparison between preoperative and postoperative outcomes

Variables	Mean (SD)		
	Preoperative	Postoperative	Change
NRS (LBP)			
Total	4.42 (2.60)	2.01 (2.00)**	−2.40 (2.62)**
Less than 40	3.71 (2.21)	1.28 (2.08)	−2.40 (3.33)*
40 – 49	3.00 (2.89)	1.05 (1.55)	−1.90 (2.01)**
50 – 59	3.66 (2.57)	2.20 (2.17)	−1.40 (2.17)**
60 – 69	4.06 (2.36)	1.97 (1.80)	−2.80 (2.49)**
70 – 79	5.24 (2.33)	2.27 (2.21)	−2.79 (2.79)**
More than 80	5.57 (2.44)	2.04 (1.83)	−3.52 (2.42)**
NRS (Leg pain)			
Total	5.74 (2.68)	1.76 (2.15)**	−3.98 (3.1)**
Less than 40	5.42 (1.76)	0.42 (0.72)	−5.00 (2.07)**
40 – 49	5.23 (3.35)	0.76 (1.21)	−4.47 (2.93)**
50 – 59	5.60 (2.99)	1.50 (2.43)	−4.12 (4.04)**
60 – 69	5.65 (2.46)	1.73 (1.89)	−3.91 (2.81)**
70 – 79	5.91 (2.47)	2.27 (2.20)	−3.62 (3.07)**
More than 80	6.23 (3.01)	2.52 (2.57)	−3.71 (3.17)**
RMDQ			
Total	10.97 (6.10)	4.50 (4.76)**	−6.4 (6.80)**
Less than 40	12.71 (5.70)	2.07 (3.34)	−10.64 (6.76)**
40 - 49	12.05 (6.69)	4.64 (4.60)	−7.41 (9.56)*
50 - 59	10.12 (5.91)	3.21 (4.25)	−6.90 (6.72)**
60 - 69	9.93 (5.58)	3.43 (3.94)	−6.5 0(6.71)**
70 -79	10.48 (6.37)	5.53 (5.39)	−4.94 (6.52)**
More than 80	13.38 (5.14)	7.19 (4.24)	−6.19 (6.07)**
EQ-5D-5L			
Total	0.55 (1.70)	0.77 (1.77)**	0.21 (0.25)**
Less than 40	0.57 (0.09)	0.83 (0.13)	0.25 (0.12)**
40 - 49	0.53 (0.23)	0.89 (0.13)	0.36 (0.25)**
50 - 59	0.59 (0.09)	0.81 (0.15)	0.21 (0.15)**
60 - 69	0.60 (0.17)	0.78 (0.15)	0.18 (0.23)**
70 -79	0.52 (0.17)	0.70 (0.19)	0.16 (0.27) **
More than 80	0.49 (0.19)	0.73 (0.18)	0.24 (0.23)**

Notes: * $p < 0.05$, ** $p < 0.01$. NRS, Numerical Rating Scale; LBP, low back pain; RMDQ, Roland-Morris Disability Questionnaire; EQ-5D-5L, EuroQol-5 Dimensions-5 Levels.

Hierarchical multiple regression analysis

Table 8 presents the hierarchical multiple regression analysis results for disability. The analysis aimed to determine the factors that significantly influence disability levels. The regression model consisted of four steps, each explaining a certain percentage of variance in disability outcomes. In step 1, the analysis explained 4.6% of the variance in disability. Moving to step 2, the model accounted for an additional 9.7% of the variance. At this stage, the preoperative RMDQ score ($B = -0.15$; $p < 0.01$) and age ($B = 0.08$; $p < 0.01$) were found to have significant associations with disability. In step 3, the model explained an additional 4.9% of the variance in disability. In this step, the significant factors associated with disability included the preoperative RMDQ score ($B = 0.15$, $p < 0.05$), age ($B = 0.08$, $p < 0.01$), and the TSK score ($B = -0.10$, $p < 0.05$). The negative value of the TSK coefficient suggests that a higher TSK score corresponds to a lower disability level. Lastly, in step 4, the model explained an additional 7.6 % of the variance in disability, bringing the total variance explained to 26.7 %. The final model revealed the significant relationships between disability and the following factors: preoperative RMDQ score ($B = 0.14$; $p < 0.05$), age ($B = 0.06$; $p < 0.05$), TSK ($B = -0.11$; $p < 0.05$), and the interaction of preoperative RMDQ score and age ($B = 0.01$; $p < 0.01$). In summary, the hierarchical multiple regression analysis demonstrated that the preoperative RMDQ score, age, TSK, and the interaction between preoperative RMDQ score and age were significantly associated with disability levels. The final model accounted for 26.7% of the variance in disability outcomes. The negative coefficient for the TSK score indicates that higher levels of kinesiophobia are related to lower disability levels. The findings highlight the importance of considering patients' age, preoperative disability levels, and psychological factors such as kinesiophobia when assessing and predicting disability outcomes in individuals undergoing surgical treatment for lumbar conditions.

Table 8. Results of the hierarchical multiple regression analysis (n = 176)

Variables	Step 1 (B)	Step 2 (B)	Step 3 (B)	Step 4 (B)
RDQ	0.17**	0.15**	0.15*	0.14*
Age		0.08**	0.08**	0.06*
Sex		0.57	0.59	0.24
LBP		0.23	0.22	0.26
PCS			0.01	0.01
TSK			-0.09*	-0.11*
HADS-A			0.17	0.13
HADS-D			0.11	0.19
RDQ*Age				0.01**
Gender*Age				-0.07
LBP*Age				0.01
PCS*Age				0.00
TSK*Age				0.00
HADS-A*Age				0.00
HADS-D*Age				-0.01
R ²	0.05	0.14	0.19	0.27
ΔR^2	0.05	0.10	0.05	0.08

Notes: *p < 0.05, **p < 0.01. RDQ: Roland-Morris Disability Questionnaire; LBP: low back pain; PCS: Pain Catastrophizing Scale; TSK: Tampa Scale for Kinesiophobia; HADS-A: Hospital Anxiety and Depression Scale – anxiety subscale; HADS-D: Hospital Anxiety and Depression Scale – depression subscale.

The simple slope test

For the simple slope test, the model with +1 SD with age showed a significant association between preoperative disability and disability at 1 year postoperatively ($r = 0.73$; $p < 0.01$). The model with -1 SD and age showed no association (Figure 8).

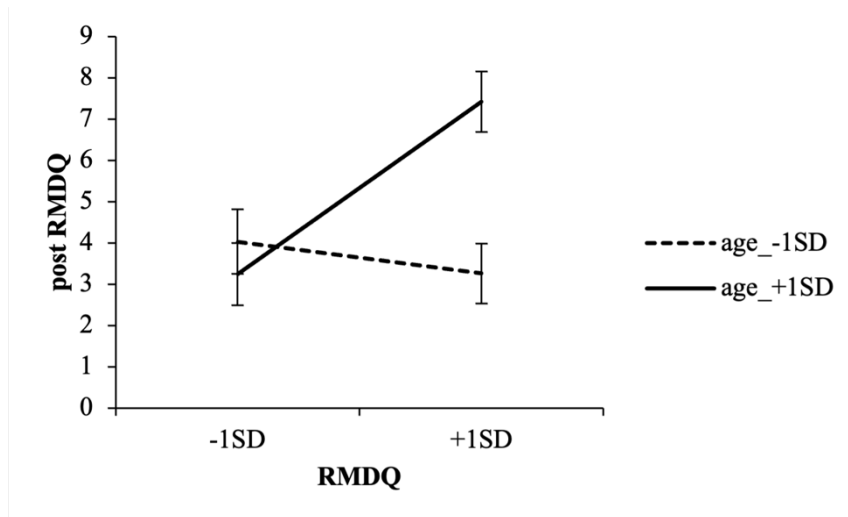


Figure 8. The interaction between preoperative RMDQ scores and age (simple slope test)

Discussion

This study predicted the disability of patients with lumbar disease more than 1 year after surgery based on multidimensional preoperative factors. This study found significant improvements in clinical symptoms in all age groups after lumbar surgery for degenerative disease, demonstrating the effectiveness of surgery although the degree of improvement varied among different age groups. The results also showed that the preoperative RMDQ scores, TSK, age, and preoperative RMDQ scores with the interaction of age were significant predictors of disability. The explanatory power was 26.7%.

This study aimed to determine the preoperative psychological factors that could predict postoperative disability in patients undergoing lumbar spine surgery. The results of this study suggest that TSK (fear of movement) was the most predictive factor of disability among various psychological factors. Several studies have reported that fear of movement predicts postoperative outcomes after spinal surgery. A study of patients undergoing surgery for lumbosacral radicular syndrome found that the fear of movement was predictive of the degree of disability at 6 weeks [140]. Other studies of patients who had undergone lumbar disc surgery found that questionnaire scores regarding avoidance beliefs before surgery could predict pain and disability 10 weeks postoperatively [141]. Similarly, another study on patients undergoing lumbar disc surgery reported that preoperative fear-avoidance beliefs predicted disability at 1 year after surgery [142]. The fear-avoidance model is a well-known theory of chronic conditions. Individuals with excessive fear of pain prioritize the control of pain that will not go away, leading to fear and avoidance. As a result, pain-related fear and avoidance behaviors may persist beyond the healing period, or protective responses may generalize to new stimuli similar to the original fear-provoking stimulus [143]. Patients with intense fear before surgery might have their behavior restricted by the above theory even after surgery, resulting in improved disability, even if the surgery was successful.

The preoperative RMDQ score was identified as a predictor, although an interaction by age was indicated. In other words, the degree of preoperative disability affects disability more than 1 year after surgery in the older age group but not in the younger age group. This result suggests that age is one of the factors that affects disability. A previous study showed that younger age positively affects postoperative walking ability [27]. In contrast, a study reported that age did not predict the outcome at 1 or 2 years postoperatively for lumbar spinal stenosis [25]. A study including individuals who underwent multilevel transforaminal lumbar interbody fusion reported that age alone was not predictive of functional outcomes at 90 days postoperatively [144]. Behrbalk et al. reported similar improvements in pain and disability across age groups

following lumbar spine surgery [145]. The current study suggests that age may influence postoperative predictors when combined with the degree of preoperative disability.

Although we did not find a significant relationship between HADS-A and HADS-D scores and postoperative disability in our study, previous research has shown mixed results. Some studies have reported that higher levels of preoperative anxiety and depression were associated with poorer outcomes after lumbar surgery [146]. However, other research has found no significant relationship between these psychological factors and postoperative outcomes [147]. The discrepancy in our findings and those of previous studies may be due to differences in the sample size, patient characteristics, or specific surgical procedures. Further research with larger sample sizes and diverse patient populations is needed to better understand the potential role of preoperative anxiety and depression in postoperative disability and recovery.

This study had some limitations. First, it was only possible to include psychological factors and none of the other patient characteristics, radiological features and social factors were included as variables in this study. Only a few factors were assessed, and we recognise that the outcome of surgical treatment of patients with degenerative lumbar disease is multifactorial, and many factors can contribute to the results. However, our study aimed to investigate the specific factors selected, particularly some psychological factors in this study. Other psychosocial factors, such as self-efficacy, stress, smoking history, and income level, could have influenced the results if they had been added to the variables. However, the factors included in this study were selected as critical factors in previous studies and can thus be considered reliable. Second, the study population was not standardized. Diseases included lumbar spinal canal stenosis and lumbar hernias. In addition, information on patients' disease severity and symptom duration needed to be standardized. This may have been one of the factors that affected the results and reduced the explanatory power of multiple regression analysis. However, since the analysis was conducted with mixed diseases in previous studies, its validity is not in question. Finally, all evaluations were conducted using PROMS, and there were no objective measures. However, the importance

of PROMS has recently been demonstrated [148].

Despite these limitations, this study's findings have several clinical implications. Focusing on psychological factors, including fear of movement, highlights the importance of rehabilitation based on the biopsychosocial model. The results of this study indicated the importance of assessing the degree of fear of movement before surgery. They also suggested the importance of a rehabilitation program to reduce fear after surgery. Wertil et al. found that fear-avoidance beliefs influenced the treatment outcomes in subacute low back pain patients. Reducing the fear of movement from an early stage is key to improving treatment outcomes [124]. A study also reported that psychological support, including that for "fear of movement," improves outcomes in post-fusion rehabilitation patients with degenerative spinal disease [149]. Cognitive-behavioral-based physical therapy for patients after lumbar spine surgery improves outcomes, including disability, at a 3-month follow-up [46]. Evidence of changing behavior through physical therapy has also been developed. Fear of movement is reported to be a mediating factor in improving disability 6 months after surgery [150]. Allaying fear will become increasingly important for rehabilitation programs in the future. A review focusing on overcoming fear has also been proposed [151].

Conclusion

This study demonstrated significant improvements in clinical symptoms across all age groups following lumbar surgery for degenerative disease although the degree of improvement varied among different age groups. In addition, preoperative RMDQ scores, TSK, age, and the interaction between preoperative RMDQ scores and age were significant predictors of postoperative disability, with fear of movement being the strongest predictor. These findings underscore the importance of implementing a biopsychosocial model in rehabilitation.

Chapter 5.

Overall discussion

In Study 1, interventions based on the BPS model contributing to the improvement of pain and disability in spinal disorders were systematically evaluated. Evidence was presented to show that interventions based on this model were more effective than those that were not based on the BPS model, but a critical issue that emerged was the overall low level of certainty of the evidence supporting the main outcomes. Specifically, the quality of evidence regarding improvement in pain was low, and while statistically significant effects were reported regardless of the duration of pain and the regions affected, their certainty was low. Furthermore, strong evidence was found that physiotherapist-led interventions are effective for neck pain, but similar effects were not observed for chronic LBP. These findings suggest the importance of individualized treatment in the application and range of effects of interventions based on the BPS model. In addition, the quality of interventions and their delivery methods may significantly influence outcomes, especially in the subgroups of specific conditions such as neck pain or chronic low back pain. The present highlights need for further attention to the adaptation and implementation of interventions.

Study 2 delved into the intricacies of factors influencing disability in individuals with acute and non-acute NSLBP. One of the pivotal findings was the substantial role of pain self-efficacy in shaping the extent of disability, a trend that stood out in both acute and non-acute phases of NSLBP. This insight is particularly enlightening as it underscores the psychological battleground on which pain is experienced and managed. The concept of self-efficacy, especially in the context of pain, goes beyond mere pain tolerance, encapsulating individuals' confidence in their ability to engage in activities despite the pain, which can profoundly influence their actual ability to navigate daily tasks and maintain functionality. The importance of changing the way we approach pain management is highlighted by the key role of pain self-efficacy in recovery from NSLBP or its development into a chronic condition. Rather than just

addressing the physical symptoms, it is considered important to provide psychological support to strengthen patients' beliefs about their own ability to manage their pain. Patients can gain a greater sense of control, which is critical to improving self-efficacy, by learning about their condition, how to manage their pain, and ways to stay active. Furthermore, the findings suggested that interventions to enhance pain self-efficacy should not have been a one-size-fits-all but needed to be tailored. In the acute phase, for instance, bolstering self-efficacy might prevent the transition from acute to chronic pain, a stage where psychological factors became increasingly cemented and could dictate the course of the disorder. Early psychological support and education about pain, its implications, and realistic management strategies were crucial during this phase. On the other hand, for the individuals in the non-acute or chronic stages, interventions might be needed to address the established belief systems and learned behaviors that contribute to sustained pain and disability. Cognitive-behavioral therapy and other psychological interventions can be pivotal in reshaping perceptions of pain, promoting adaptive coping strategies, and ultimately, enhancing pain self-efficacy. These approaches, might couple with traditional physical therapies, could provide a holistic treatment regimen, addressing both the mental and physical aspects of NSLBP.

Study 3 embarked on a predictive quest, seeking to understand the multiple preoperative factors that could predict postoperative disability in lumbar spine patients over one year after surgery. Significant improvements in clinical symptoms were observed in all age groups, confirming the efficacy of the surgical intervention, according to the study's approach. However, the magnitude of improvement was not uniform and was significantly influenced by preoperative factors, underscoring the predictive power of pre-surgery disability levels, fear of movement, and age. A critical revelation from this study was the potent influence of psychological variables, such as fear of movement, on postoperative recovery trajectories. This fear, often assessed through tools like the TSK, has been linked to avoidance behavior and physical deconditioning, creating a vicious cycle that can impede recovery. The findings in Study 3 suggested that

addressing these fears through pre- and postoperative interventions could significantly alter the patient's recovery landscape. Cognitive-behavioral strategies, physiotherapy, and education about surgery and recovery processes could mitigate these fears, potentially improving postoperative outcomes. Interestingly, the interaction between age and preoperative RMDQ scores in predicting postoperative disability underscores the complex interplay between physical and psychological health. It suggests that younger individuals with lower preoperative disability levels might recover more robustly, challenging the notion that youth universally predict better outcomes. The study also casts a spotlight on the need for robust preoperative screening processes. Identifying high-risk patients, those with severe preoperative disability, high fear of movement, or advanced age, could trigger early interventions. These might include psychological support, physical conditioning programs, and setting realistic expectations for surgery and recovery, all aimed at optimizing the preoperative status of patients.

The overarching narrative from these studies emphasizes the intricate complexity and multidimensional nature of LBP. It is clear that effective management extends beyond symptomatic treatment, demanding a holistic strategy that considers the psychological, physical, and social facets of a patient's experience.

The clinical implications of these studies suggest that the effective management of LBP is not limited to the treatment of physical symptoms alone. It requires the creation of tailored treatment plans that integrate the BPS aspects of each patient's condition. In addition to physical assessments, preoperative evaluations should include psychological resilience and attitudes toward pain. Multidisciplinary teams informed by the PBS model are essential to provide comprehensive care that addresses mental, physical, and social health. For instance, patient education should focus on the biopsychosocial factors of pain, equipping individuals with strategies to manage their condition proactively. Postoperative care should continue this holistic approach, supporting patients toward full recovery. Training clinicians, including physical therapists, in the biopsychosocial model is essential to ensure a deep understanding of the

complexities of LBP and to apply the latest evidence-based practices. This approach is key to improving LBP management and reducing patient disability.

Chapter 6.

Conclusions

In this thesis, three studies were conducted to see to explore the multifaceted nature of disability for LBP and the effectiveness of the BPS model in its management. In the first study, a systematic review and analysis of the impact of BPS-based interventions on disability through a meta-analysis of spinal cord disorders underscored the importance of the BPS model. The second study examined factors affecting disability in acute and post-acute NSLBP, with a focus on psychological factors. The t study examined factors influencing disability in LBP with surgical indications, focusing on psychological factors. The following conclusions were led from the results of these studies.

- 1 . Physiotherapist-led interventions based on the BPS model are found effective for disability in spinal disorders, including LBP.
- 2 . In NSLBP, pain self-efficacy had a significant association with disability regardless of time period.
- 3 . In postoperative LBP, preoperative RMDQ scores, fear of movement, and age were significant predictors of postoperative disability, and fear of movement was indicated as the strongest predictor.

The value of this thesis was the demonstration of how the BPS model can effectively address disability from spinal problems, including LBP. It suggests that we need to change the way we treat these conditions to include psychological factors, such as self efficacy with pain and fear of movement, which are important in determining how well patients do after treatment. The potential for future development from this thesis focuses on improving the application of the BPS model in the management of LBP. Future research can build on this work by testing how well BPS-based treatments work over time and developing tools to predict how patients will fare after surgery. These efforts could potentially change the way to manage LBP around the world.

Chapter 7.

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Appendices

Appendix 1: Search Strategy

MEDLINE

- S1 (MH "Spinal Diseases+")
- S2 Spinal Disorder
- S3 (MH "Cauda Equina")
- S4 (MH "Spine+")
- S5 (MH "Neck Pain")
- S6 neck NEAR3 pain
- S7 (MH "Back Pain+")
- S8 back NEAR3 pain
- S9 Backache
- S10 (MH "Hernia+")
- S11 (MH "Radiculopathy")
- S12 whiplash associated disorder
- S13 lumbar stenosis or lumbar spinal stenosis
- S14 (MH "Failed Back Surgery Syndrome") or Failed Back Surgery Syndrome
- S15 spinal fusion
- S16 lumbar surgery
- S17 spine surgery
- S18 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR
S12 OR S13 OR S14 OR S15 OR S16 OR S17
- S19 (MH "Pain Management")
- S20 (MH "Patient Education as Topic+")
- S21 (MH "Patient Care Management+")
- S22 (MH "Comprehensive Health Care+")
- S23 (MH "Pain Clinics")
- S24 (MH "Social Support+")
- S25 (MH "Psychosocial Support Systems")
- S26 (MH "Interviews as Topic")
- S27 multidisciplinary biopsychosocial rehabilitation
- S28 cognitive functional therapy or cft
- S29 pain neuroscience education
- S30 mindfulness
- S31 coping
- S32 biopsychosocial
- S33 motivational interviewing
- S34 interdisciplinary
- S35 S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR
S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34
- S36 (MH "Randomized Controlled Trials as Topic+") or randomiz* controll* trial*
- S37 (MH "Controlled Clinical Trials as Topic+") or controll* clinical trial
- S38 "randomized"
- S39 placebo*
- S40 Drug Therapy
- S41 "randomly"
- S42 trial
- S43 "groups"
- S43 S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43
- S44 (MH "Humans") OR "humans"
- S45 (S43 AND S44)

CENTRL

- #1 MeSH descriptor: [Spinal Diseases] explode all trees
- #2 MeSH descriptor: [Cauda Equina] explode all trees
- #3 MeSH descriptor: [Spine] explode all trees
- #4 MeSH descriptor: [Vertebrates] explode all trees
- #5 MeSH descriptor: [Neck Pain] explode all trees
- #6 (neck NEAR3 pain):ti,ab,kw
- #7 MeSH descriptor: [Back Pain] explode all trees
- #8 back NEAR3 pain
- #9 (Backache):ti,ab,k
- #10 MeSH descriptor: [Hernia] explode all trees
- #11 MeSH descriptor: [Radiculopathy] explode all trees
- #12 MeSH descriptor: [Whiplash Injuries] explode all trees
- #13 (whiplash disorder):ti,ab,kw
- #14 (lumber stenosis):ti,ab,kw
- #15 MeSH descriptor: [Failed Back Surgery Syndrome] explode all trees
- #16 (Failed Back Surgery Syndrome):ti,ab,kw
- #17 MeSH descriptor: [Spinal Fusion] explode all trees
- #18 (spinal fusion):ti,ab,kw
- #19 (lumbar surgery):ti,ab,kw
- #20 (spine surgery):ti,ab,kw
- #21 {OR #1-#20}
- #22 MeSH descriptor: [Cognitive Behavioral Therapy] explode all trees
- #23 (Cognitive Behavioral Therapy):ti,ab,kw
- #24 MeSH descriptor: [Pain Management] explode all trees
- #25 MeSH descriptor: [Patient Education as Topic] explode all trees
- #26 MeSH descriptor: [Patient Care Management] explode all trees
- #27 MeSH descriptor: [Comprehensive Health Care] explode all trees
- #28 MeSH descriptor: [Pain Clinics] explode all trees
- #29 MeSH descriptor: [Social Support] explode all trees
- #30 MeSH descriptor: [Psychosocial Support Systems] explode all trees
- #31 MeSH descriptor: [Interviews as Topic] explode all trees
- #32 (multidisciplinary biopsychosocial rehabilitation):ti,ab,kw
- #33 (cognitive functional therapy):ti,ab,kw
- #34 (pain neuroscience education):ti,ab,kw
- #35 (mindfulness):ti,ab,kw
- #36 (coping):ti,ab,kw
- #37 (biopsychosocial):ti,ab,kw
- #38 (motivational interviewing):ti,ab,kw
- #39 (interdisciplinary):ti,ab,kw
- #40 {OR #22-#39}
- #41 #21 AND #39

CINAHL (EBSCO host)

#1

MW Spinal Diseases OR MW Cauda Equina OR MW Spine OR MW Vertebrates OR MW Neck Pain OR MW Back Pain OR MW Hernia OR MW Radiculopathy OR MW Whiplash Injuries OR MW Failed Back Surgery Syndrome OR MW Spinal Fusion OR TX Backache OR

TX whiplash disorder OR TX lumbar stenosis OR TX Failed Back Surgery Syndrome OR TX lumbar surgery OR TX spine surgery

#2

MW cognitive behavioral therapy OR TX cognitive behavioral therapy OR MW pain management OR MW patient education OR MA patient education as topic OR MW patient care management OR MW Comprehensive Health Care OR MW Pain Clinics OR MW Social Support OR MW Psychosocial Support Systems OR MW Interviews as Topic OR TX multidisciplinary biopsychosocial rehabilitation OR TX cognitive functional therapy OR TX pain neuroscience education OR TX mindfulness OR TX coping OR TX biopsychosocial OR TX motivational interviewing OR TX interdisciplinary

#3

TX randomized controlled trials OR TX controlled clinical trial OR TX randomized OR TX placebo OR TX drug therapy OR TX randomly OR TX trial OR TX groups OR TX human

#4

#1 AND #2 AND #3

PsychoINFO (EBSCO host)

#1

MA spinal diseases OR MA cauda equina OR MA spine OR MA vertebrates OR MA neck pain OR MA back pain OR MA hernia OR MA radiculopathy OR MA whiplash OR MA whiplash injury OR TX whiplash disorder OR TX lumbar stenosis OR MA failed back surgery syndrome OR TX failed back surgery syndrome OR MA spinal fusion OR TX lumbar surgery

#2

MA cognitive behavioral therapy OR TX cognitive behavioral therapy OR MA pain management OR MA patient education OR MA patient education as topic OR MA patient care management OR MA Comprehensive Health Care OR MA Pain Clinics OR MA Social Support OR MA Psychosocial Support Systems OR MA Interviews as Topic OR TX multidisciplinary biopsychosocial rehabilitation OR TX cognitive functional therapy OR TX pain neuroscience education OR TX mindfulness OR TX coping OR TX biopsychosocial OR TX motivational interviewing OR TX interdisciplinary

#3

TX randomized controlled trials OR TX controlled clinical trial OR TX randomized OR TX placebo OR TX drug therapy OR TX randomly OR TX trial OR TX groups OR TX human

#4. #1 AND #2 AND #3

Web of Science

TS=(((Spin* Diseases or Cauda Equina or Vertebrates or Hernia or Radiculopathy or whiplash disorder or Failed Back Surgery Syndrome Spinal Fusion or Backache or lumbar stenosis or (lumbar or spine) surgery) AND (cognitive behavioral therapy or pain management or patient education or patient education or patient care management or Comprehensive Health Care or Pain Clinics or Social Support or Psychosocial Support Systems or Interviews or multidisciplinary biopsychosocial rehabilitation or cognitive functional therapy or pain neuroscience education or mindfulness or coping or biopsychosocial or motivational interviewing or interdisciplinary)) AND (random* controlled trial or controll* clinical trial))

PEDro

Abstract & Title: any

Therapy: behaviour modification, education, fitness training

Problem: pain

Body Part: head or neck, thoracic spine, lumbar spine, sacro-iliac joint or pelvis

Method: clinical trial

Appendix 2. Summary of studies included

	Sample size (Experimental/control)	Condition/Stage	Interventions (Duration/contact)	Comparisons (Duration/contact)	Received training in BPS model interventions	Outcome measures	Follow up
Abbott et al. 2010; Sweden	53/54	After lumbar surgery/acute and subacute	Psychomotor Therapy 12 wk period, 90 min per session.	Exercise Therapy 12 wk period, 20 min per session.	No	VAS ODI TSK	3 mo 6 mo 12 mo 2–3 yr
Alacreu et al. 2015; Spain	15/14	Neck pain/chronic	Manual therapy, therapeutic patient education, and a therapeutic exercise 4 wk with two sessions of treatment per week for a total of eight sessions.	Manual therapy 4 wk with two sessions of treatment per week for a total of eight sessions.	No	VAS NDI TSK-11 FABQ	4 wk 8 wk 16 wk
Alves et al. 2022; Portugal	27/20	Low back pain/chronic	Pain neuroscience education and graded exposure 8 wk with 60 min each of eight sessions	Pilates and postural education 8 wk with 60 min each of eight sessions	Yes	NRS ODI PCS FABQ	Post 3 mo
Andias et al. 2018; Portugal	21/22	Neck pain/chronic	Pain neuroscience education and neck/shoulder exercises 45-60 min per sessions	No intervention	No	VAS PCS STAIC	5 wk
Andias et al. 2022; Portugal	68/59	Neck pain/chronic	Pain neuroscience education and exercise PNE 15-45 mins per session, exercise was 8 session	Exercise 8 session	No	NRS FDI PCS TSK CSES	Post 6 mo

Angela et al. 2013; Hong Kong	24/23	Low back pain/acute and subacute	Integrated work rehabilitation with cognitive behavioural approach 3 months maximally, 30 min per session.	Conventional treatment 3 months maximally, 15 min per session.	Yes	NRS RDQ ODI PSEQ TSK-11	Post treatment
Archer et al. 2016; USA	43/43	After lumbar surgery/acute	Cognitive-behavioral based physical therapy 1 sessions a wk for six wk.	Education 1 sessions a wk for six wk.	Yes	BPI ODI	Post treatment 3 mo
Bagheri et al. 2020; Iran	23/22	Low back pain/chronic	Cognitive Behavioral Therapy With Stabilization Exercises Total of 8 sessions Cognitive Behavioral Therapy and Total of 24 sessions exercise, 3 sessions per wk for a total of 8 wk.	Stabilization Exercises Total of 24 sessions, 3 sessions per wk for a total of 8 wk.	No	RDQ FABQ	8 wk
Brage et al. 2015; Denmark	11/9	Neck pain/chronic	Pain education and specific training four sessions of 1.5 hours of pain education, and eight supervised training sessions of 0.5 hour.	Pain education alone four sessions of 1.5 hours.	Yes	NRS NDI	Post- treatment
Bring et al. 2015; Sweden	18/19	WAD/acute	Tailored behavioural programme 5-10 wk period, 60 min per session	standard treatment	No	NRS PDI PSEQ TSK	Post treatment 3 mo 6 mo 12 mo
Brox et al, 2003; Norway	26/35	Low back pain and Disc Degeneration/chronic	Cognitive intervention and exercises 25 h per week for 3 weeks.	Posterolateral fusion with pedicle fixation	No	VAS ODI FABQ	12 mo

Brox et al. 2006; Norway	29/28	Low back pain/chro nic	Cognitive intervention and exercises 25 h per week for 3 weeks.	Posterolateral fusion with pedicle fixation	No	VAS ODI FABQ	12 mo
Castrillo et al. 2021;Spain	21/19	Neck pain/chro nic	Pain neuroscience education and dry needling 3 days per week over 2 weeks (a total of six sessions of dry needling) and PNE for 30 min during the week	Usual care five electrotherapy sessions per week (one per day) for 2 weeks (total of 10 sessions)	Yes	VAS NDI TSK PCS PASS	Post- treatment 1 mo 3 mo
Castro et al. 2022: Brazil	74/74	Low back pain/chro nic	Cognitive functional therapy 5 one-hour sessions for an 8-week intervention period, on a weekly basis for the first 2 weeks and then a session every 2 or 3 weeks	core stability exercise + manual therapy 30-min exercise session at 3 times a week.	Yes	NRS ODI	8 wk 6 mo 12 mo
Critchley et al. 2007; UK	69/71	Low back pain/suba cute and chronic	Pain managment Maximum of 8 sessions of 90 min.	Individual physical therapy 12 sessions of around 30 min.	Yes	VAS RDQ	6 mo 12 mo 18 mo
Erp et al. 2021; the Netherlands	12/13	Low back pain/chro nic	Biopsychosocial primary care Four individual sessions (30minutes) and eight group sessions (60minutes).	Physiotherapy The maximum of twelve sessions	Yes	NRS PDI TSK PCS HADS PSEQ	Post- treatment 3 mo
Fersum et al. 2013; Norway	62/59	Low back pain/chro nic	Cognitive functional therapy 12 wk period, 30-45 min per session.	Manual therapy and exercise 12 wk period, 30 min per session.	Yes	NRS ODI FABQ	3 mo 12 mo

Friedrich et al. 1998; Austria	44/49	Low back pain/chronic	Exercise and motivation program 2 to 3 sessions per week, a total of 10 sessions, 25 min per session.	Standard exercise program 2 to 3 sessions per week, a total of 10 sessions, 25 min per session.	Yes	NRS Low Back Outcome Scale Questionnaire	Post- treatment 4 mo 12 mo
George et al. 2003; USA	34/33	Low back pain/acute	Fear-avoidance– based physical therapy 4 wk period, 60 min per session.	Physical therapy 4 wk period, 60 min per session.	Yes	NRS ODI FABQ	4 wk 6 mo
George et al. 2008; USA	35/36	Low back pain/acute, subacute, and chronic	Graded exposure Graded exercise 45-60 min per session.	Standard care 45-60 min per session.	Yes	NRS ODI FABQ PCS	4 wk 6 mo
Gorji et al, 2022	18/19	Low back pain/chronic	Pain neuroscience education (PNE) + motor control exercise (MCE) PNE one session 30-60min, MCE 16 sessions for 8 wk	core stability exercise 3 sessions per week, 45–60 min each session	No	VAS RDQ	8 wk

Appendix 3. The results of the certainty of the evidence using the GRADE approach (All group)

Quality assessment						Summary of findings		
No of studies	Risk of bias	Imprecision	Inconsistency	Indirectness	Publication bias	No of participants	Pooled standardized mean difference (95% confidence intervals)	Quality of evidence
The BPS model of intervention versus the non-BPS model of intervention on pain in the short term								
37	Not serious	Not serious	Very Serious	Not serious	Undetected	2659	-0.44 (-0.62 to -0.27)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on pain in the medium term								
38	Not serious	Not serious	Very Serious	Not serious	Undetected	4201	-0.24 (-0.37 to -0.12)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on pain in the long term								
24	Not serious	Not serious	Very Serious	Not serious	Undetected	2991	-0.17 (-0.28 to -0.06)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on disability in the short term								
36	Not serious	Not serious	Very Serious	Not serious	Undetected	2585	-0.48 (-0.69 to -0.27)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on disability in the medium term								
37	Not serious	Not serious	Very Serious	Not serious	Undetected	3934	-0.44 (-0.64 to -0.25)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on disability in the long term								

24	Not serious	Not serious	Very Serious	Not serious	Undetected	3000	-0.37 (-0.58 to -0.15)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on fear of movement in the short term								
20	Not serious	Not serious	Very Serious	Not serious	Undetected	1320	-1.07 (-1.49 to -0.65)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on fear of movement in the medium term								
23	Not serious	Not serious	Very Serious	Not serious	Undetected	2374	-0.75 (-1.08 to -0.43)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on fear of movement in the long term								
12	Not serious	Not serious	Very Serious	Not serious	Undetected	1416	-1.13 (-1.68 to -0.57)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on catastrophizing in the short term								
12	Not serious	Not serious	Serious	Not serious	Undetected	814	-0.45 (-0.71 to -0.19)	⊕⊕⊕○ MODERATE
The BPS model of intervention versus the non-BPS model of intervention catastrophizing in the medium term								
12	Not serious	Not serious	Very Serious	Not serious	Undetected	1119	-0.56 (-0.95 to -0.16)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention catastrophizing in the long term								
4	Serious	Serious	Very Serious	Not serious	Undetected	593	-0.72 (-1.67 to 0.22)	⊕○○○ VERY LOW
The BPS model of intervention versus the non-BPS model of intervention on anxiety in the short term								
4	Serious	Serious	Not serious	Not serious	Undetected	401	-0.12 (-0.32 to 0.08)	⊕⊕○○ LOW

The BPS model of intervention versus the non-BPS model of intervention on anxiety in the medium term								
5	Not serious	Serious	Not serious	Not serious	Undetected	633	-0.13 (-0.29 to 0.03)	⊕⊕⊕○ MODERATE
The BPS model of intervention versus the non-BPS model of intervention on anxiety in the long term								
3	Serious	Serious	Not serious	Not serious	Undetected	490	-0.02 (-0.25 to 0.20)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on depression in the short term								
5	Not serious	Not serious	Not serious	Not serious	Undetected	441	-0.26 (-0.45 to -0.07)	⊕⊕⊕⊕ HIGH
The BPS model of intervention versus the non-BPS model of intervention on depression in the medium term								
8	Not serious	Serious	Serious	Not serious	Undetected	1145	-0.16 (-0.40 to 0.07)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on depression in the long term								
4	Not serious	Serious	Serious	Not serious	Undetected	804	-0.05 (-0.36 to 0.25)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on Self-efficacy in the short term								
13	Serious	Not serious	Serious	Not serious	Undetected	1115	0.67 (0.25 to 1.10)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on Self-efficacy in the medium term								
9	Not serious	Serious	Serious	Not serious	Undetected	934	0.15 (-0.10 to 0.41)	⊕⊕○○ LOW
The BPS model of intervention versus the non-BPS model of intervention on Self-efficacy in the long term								

7	Serious	Not serious	Not serious	Not serious	Undetected	808	0.26 (0.10 to 0.42)	⊕⊕⊕○ MODERATE
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Appendix 4. Questionnaires for this study: Roland morris disability questionnaire

ローランドモリス機能障害質問票

評価日 年 月 日

氏名

腰が痛い、ふだんやっていることがなかなかできなくなることがあります。以下の項目は、腰が痛いときに起こることを表したものです。この中に、あなたの「今日」の状態にあてはまるものがあるかもしれません。項目を読みながら、今日のあなたの状態を考えてみてください。あなたの状態にあてはまる場合には「はい」に、あてはまらない場合には「いいえ」に○をつけてください。

今日、腰痛のために

1	腰痛のため、大半の時間、家にいる	はい いいえ
2	腰痛を和らげるために、何度も姿勢を変える	はい いいえ
3	腰痛のため、いつもよりゆっくり歩く	はい いいえ
4	腰痛のため、ふだんしている家の仕事を全くしていない	はい いいえ
5	腰痛のため、手すりを使って階段を上る	はい いいえ
6	腰痛のため、いつもより横になって休むことが多い	はい いいえ
7	腰痛のため、何かにつかまらないうと、安楽椅子（体を預けて楽に座れる椅子、深く腰掛けた姿勢）から立ち上がれない	はい いいえ
8	腰痛のため、人に何かしてもらおうよう頼むことがある	はい いいえ
9	腰痛のため、服を着るのにいつもより時間がかかる	はい いいえ
10	腰痛のため、短時間しか立たないようにしている	はい いいえ
11	腰痛のため、腰を曲げたりひざまづいたりしないようにしている	はい いいえ
12	腰痛のため、椅子からなかなか立ち上がれない	はい いいえ
13	ほとんどいつも腰が痛い	はい いいえ
14	腰痛のため、寝返りがうちにくい	はい いいえ
15	腰痛のため、あまり食欲がない	はい いいえ
16	腰痛のため、靴下やストッキングをはくとき苦勞する	はい いいえ
17	腰痛のため、短い距離しか歩かないようにしている	はい いいえ
18	腰痛のため、あまりよく眠れない (痛みのために睡眠薬を飲んでいる場合は「はい」を選択して下さい)	はい いいえ
19	腰痛のため、服を着るのを誰かに手伝ってもらう	はい いいえ
20	腰痛のため、一日の大半を、座って過ごす	はい いいえ
21	腰痛のため、家の仕事をするとき力仕事をしないようにしている	はい いいえ
22	腰痛のため、いつもより人に対していらいらしたり腹が立ったりする	はい いいえ
23	腰痛のため、いつもよりゆっくり階段を上る	はい いいえ
24	腰痛のため、大半の時間、ベッド（布団）の中にいる	はい いいえ

Appendix 5. Questionnaires for this study: Pain Catastrophizing Scale

Pain Catastrophizing Scale (PCS)

評価日 年 月 日
氏名

この質問紙では、痛みを感じている時のあなたの考えや感情についてお聞きします。以下に、痛みに関連したさまざまな考えや感情が13項目あります。痛みを感じている時に、あなたはこれらの考えや感情をどの程度経験していますか。あてはまる数字に○をつけてお答え下さい。

	全くあてはまらない	あまりあてはまらない	どちらともいえない	少しあてはまる	非常にあてはまる
1. 痛みが消えるかどうか、ずっと気にしている	0	1	2	3	4
2. もう何もできないと感じる	0	1	2	3	4
3. 痛みはひどく、決して良くならないと思う	0	1	2	3	4
4. 痛みは恐ろしく、痛みで圧倒されると思う	0	1	2	3	4
5. これ以上耐えられないと感じる	0	1	2	3	4
6. 痛みがひどくなるのではないかと怖くなる	0	1	2	3	4
7. 他の痛みについて考える	0	1	2	3	4
8. 痛みが消えることを強く望んでいる	0	1	2	3	4
9. 痛みについて考えないようにすることはできないと思う	0	1	2	3	4
10. どれほど痛むかということばかり考えてしまう	0	1	2	3	4
11. 痛みが止まって欲しいということばかり考えてしまう	0	1	2	3	4
12. 痛みを弱めるために私ができることは何もない	0	1	2	3	4
13. 何かひどいことが起きるのではないかと思う	0	1	2	3	4

Appendix 6. Questionnaires for this study: Tampa Scale for Kinesiophobia

Tampa Scale for Kinesiophobia (TSK)

評価日 年 月 日

氏名 _____

それぞれの質問をよく読み、あなたの考えや気持ちとして最もよくあてはまる数字に○をつけてください

	少しも そう思わない	そう 思わない	そう思う	強く そう思う
1. 運動すると体を傷めてしまうかもしれないと不安になる	1	2	3	4
2. 痛みが増すので何もしたくない	1	2	3	4
3. 私の体には何か非常に悪いところがあると感じている	1	2	3	4
4. 運動した方が私の痛みはやわらぐかもしれない	1	2	3	4
5. 他の人は私の体の状態のことなど真剣に考えてくれていない	1	2	3	4
6. アクシデント(痛みが起こったきっかけ)のせいで、私は一生痛みが起こりうる体になった	1	2	3	4
7. 痛みを感じるのは、私の体を傷めたことが原因である	1	2	3	4
8. 私の痛みが何かで悪化しても、その何かを気にする必要はない	1	2	3	4
9. 予期せず体を傷めてしまうかもしれないと不安になる	1	2	3	4
10. 不必要な動作を行わないように、とにかく気をつけることが、私の痛みを悪化させないためにできる最も確実なことである	1	2	3	4
11. この強い痛みは私の体に何か非常に悪いことが起こっているからに違いない	1	2	3	4
12. 私は痛みがあっても、体を動かし活動的であれば、かえって体調は良くなるかもしれない	1	2	3	4
13. 体を傷めないように、痛みを感じたら私は運動をやめる	1	2	3	4
14. 私のような体の状態の人は、体を動かし活動的であることは決して安全とはいえない	1	2	3	4
15. 私はとても体を傷めやすいので、全てのことを普通の人と同じようにできるわけがない	1	2	3	4
16. 何かして私が強い痛みを感じたとしても、そのことでさらに体を傷めることになるとは思わない	1	2	3	4
17. 痛みがある時は、誰であっても運動することを強要されるべきではない	1	2	3	4

※短縮版 (TSK -11) は1, 2, 3, 5, 6, 7, 10, 11, 13, 15, 17の11項目である。

Appendix 7. Questionnaires for this study: Pain Self-Efficacy Questionnaire

現時点で「痛みはあってもこれらの事柄ができる」という自信の程度を教えてください。

0は「まったく自信がない」、6は「完ぺきな自信がある」です。それぞれの項目の下番号を1つ選んで○をつけてください

記入例

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

この質問票は以下の事柄をあなたが今まで実際に行ってきたかどうかではなく、「痛みはあるけれども、現時点でこれらの事柄を行える自信がどの程度あるか」を尋ねるものです。

1 痛みがあっても物事を楽しめる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

2 痛みがあっても家事のほとんど(掃除や皿洗いなど)をこなせる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

3 痛みがあっても友達や家族とこれまで通りに付き合える。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

4 ほとんどの場合痛みに対応できる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

5 痛みがあっても何か仕事ができる(仕事には家事も報酬のある仕事もない仕事も含む)。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

6 痛みがあっても趣味や気晴らしなどの楽しいことがたくさんできる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

7 薬がなくても痛みに対応できる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

8 痛みがあっても人生の目標のほとんどを達成できる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

9 痛みがあってもふつうに生活できる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

10 痛みがあっても徐々に活動的になれる。

0 1 2 3 4 5 6
全く自信がない 完ぺきな自信がある

10. List of achievements

本論文の一部は以下の論文に発表した。

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