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Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The effect of physical therapy via direct access on pain and disability levels in patients with acute low back pain

Jana Verwimp
Julie Vorsselmans

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij neurologische aandoeningen

PROMOTOR :
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Acknowledgments

We would like to express our gratitude to several individuals who supported us during the execution of our thesis. First, we would like to thank our supervisor, Prof. Dr. Lotte Janssens, for providing valuable advice and feedback throughout the preparation and execution of our thesis. Additionally, we express our appreciation to our supervisor, Dr. Nina Goossens, for her guidance and willingness to answer our questions. We are grateful for her availability and committed support. Furthermore, we would like to acknowledge Dr. Pieter Severijns for initiating the project, the support and for providing the dataset of participants. We also extend our thanks to Dr. Anna Ivanova and CENSTAT, who provided valuable assistance with questions on statistical analysis. Lastly, we would like to express our appreciation to all the participants who took part in the study. Your involvement was essential to the success of our research.

Situating

This thesis is situated in the Lumbopelvic Pain lab of Prof. Dr. Lotte Janssens, which is embedded in the REVAL Rehabilitation Research Center of UHasselt. It aligns within the framework of 'Clinical care pathways & guidelines in rehabilitation'. This thesis is part of the ongoing project: 'Direct access to physiotherapy for acute low back pain: a pragmatic pilot study (the Direct-Physio study)', coordinated by Dr. Pieter Severijns and Drs. Corentin Denis, under the supervision of Prof. Dr. Lotte Janssens. This project was realised in collaboration with KU Leuven, UAntwerpen, UCLauvain and was commissioned by RIZIV-INAMI (*Een Zorgverlener Zoeken|RIZIV*, z.d.). The study was conducted in clinical physiotherapy practices across Belgium, with Dr. Nina Goossens and Pieter Verschueren managing the recruitment of the Dutch-speaking participants and Drs. Corentin Denis overseeing the recruitment of French-speaking participants. The study population consists of individuals with acute low back pain (LBP), one of the major causes of disability worldwide.

The project only includes an experimental group, i.e. patients receiving physical therapy via direct access (DA). No comparison was made with a control group, e.g. patients receiving physical therapy.

In this study, we wanted to explore whether DA to physical therapy would be a beneficial change in the Belgian healthcare system for patients. Studies have demonstrated that DA to physical therapy provides organizational and economic benefits. However, the benefits of clinical outcomes are less clear.

The Belgian law of 10 May 2015 regarding the practice of the healthcare professions describes the rules in Belgium in relation to DA or referral. It states that physical therapists may only provide therapy to patients who are referred to the physiotherapist with a prescription from the general practitioner. The prescription contains the diagnosis made by the general practitioner. The general practitioner may request a certain treatment or performance to treat the patient. If the physiotherapist disagrees and wants to perform a different treatment than the one requested, it must first be approved by this general practitioner (Coordinated law on the practice of health professions, 2015, § 3, art. 43, lid 6).

An important element complicating DA to physical therapy is the reimbursement policy. In several cases, such as in Belgium, reimbursement is only guaranteed if one has a prescription from the physician. If the law were to recognise the profession of physical therapy as an autonomous

profession (able to accept patients through direct access), this would be a good step towards achieving DA (Bury & Stokes, 2013).

The thesis was authored by Jana Verwimp and Julie Vorsselmans, master students in physiotherapy. The research question was selected through consultation with Dr. Nina Goossens. Afterwards, the master students performed statistical analysis with guidance of Dr. Anna Ivanova of CENSTAT, and wrote the thesis, demonstrating a professional and collaborative approach.

Table of content

Abstract

Background: Direct access (DA) to physical therapy has several economic and organisational advantages. Yet, the clinical outcomes of pain and disability in the context of direct DA to physical therapy are insufficiently researched, with no studies conducted in Belgium.

Objectives: In this clinical trial, the primary objective was to examine the effect of DA to physical therapy on pain and disability levels, in individuals with acute low back pain (LBP). The second objective was to provide clarity on possible factors influencing these outcomes.

Methods: In total, 20 participants with acute LBP were included. All participants received physical therapy via DA. Pain and disability were measured at baseline, six weeks, and three months after the start of the intervention using the Numeric Pain Rating Scale (NPRS) and the Oswestry Disability Index (ODI), respectively. In addition, body mass index (BMI), age, and fear-avoidance beliefs (Fear-Avoidance Beliefs Questionnaire (FABQ) and Back Pain Attitude Questionnaire (Back-PAQ)) were measured at baseline. For the first objective, six sample t-tests were performed. Twelve linear regressions were then performed for each outcome to check for influencing factors. Power analysis showed a low risk of type II error for the one-sample t-tests, but a high risk for the single linear regressions.

Results: There was a significant improvement in average pain intensity over the past seven days ($p < 0.001$) and past 24 hours ($p < 0.001$; $p = 0.004$), as well as disability ($p < 0.001$), both after six weeks and three months. Baseline scores of the Back-PAQ explained a significant proportion of the variability in the evolution of disability, both after six weeks ($p = 0.0036$) and three months ($p = 0.004$).

Conclusion: Pain intensity and disability in patients with acute LBP can be improved by physical therapy through DA. Fear-avoidance beliefs at baseline were found to influence the evolution of pain intensity and disability, with higher scores related to less improvement. To ensure these findings, future research is recommended to include a control group receiving usual care.

Keywords: acute low back pain, direct access, physical therapy, pain, disability, fear-avoidance beliefs

Introduction

Low back pain (LBP) is one of the major causes of disability worldwide (Wu et al., 2020). LBP presents a multifaceted health problem in which biophysical, psychological, social, and genetic factors may collectively contribute to its manifestation (Hartvigsen et al., 2018). The European guideline defines acute LBP as a period of less than six weeks (van Tulder et al., 2006). The greatest recovery occurs within the initial six weeks, after which progress slows down, with 28.2% not recovered after one year (Henschke et al., 2008). LBP creates socio-economic burdens, due to high medical expenses and work absences (Ritzwoller et al., 2006; Serranheira et al., 2020). The Belgian clinical guideline for LBP expresses the importance of individualised rehabilitation and a broad clinical assessment paying attention to red flags and other body regions possibly contributing to the problem (van Wambeke et al., 2020). Van Wambeke et al. (2020) concentrate on excluding signs and symptoms of serious underlying medical conditions, a proactive approach, and prevention of chronicity in the treatment of LBP.

Bury and Stokes (2013) describe direct access (DA) to physical therapy or self-referral to physical therapy as a pathway of care where patients can refer themselves directly to a physical therapist without first contacting a physician and getting a referral. Many countries have already implemented this care pathway, such as Ireland, Greece and Sweden (Kroneman et al., 2006). DA to physical therapy has many benefits. The care pathway reduces the high workload for general practitioners, which is an organisational advantage for the physician (Holdsworth et al., 2007), and leads to faster access to physical therapy due to shorter waiting times, allowing patients to start rehabilitation sooner (Holdsworth & Webster, 2004). Liu et al. (2018) showed that immediate initiation of physical therapy (within three days) resulted in lower healthcare use and costs in individuals presenting acute LBP. Moreover, Bornhoft et al. (2019) showed that the risk of chronicity in patients with musculoskeletal pathologies was slightly lower when patients self-referred to physical therapy compared to when being referred by a general practitioner after six months, but not after one year. Furthermore, DA to physical therapy is economically beneficial because it leads to a reduction in drug prescription, imaging, emergency department visits and pharmacy costs (Frogner et al., 2018).

There are still inconsistencies in the literature regarding the impact of physical therapy via DA on clinical outcomes, such as pain and disability. In the study by Brooks et al. (2008), disability was less prevalent in patients who accessed physical therapy through DA compared to those who were

referred by their general practitioner. However, some studies did not find any differences in improvement in pain and disability between the DA and the referral groups (Denninger et al., 2018). The clinical outcomes pain and disability in the context of DA are insufficiently researched, with no studies conducted in Belgium on this matter.

Demographic, anthropometric and cognitive factors may influence LBP. Research indicates that individuals with higher BMI are more likely to develop chronic LBP (Sadeghi-Yarandi et al., 2022). Additionally, the study reveals that individuals with chronic LBP exhibit higher scores on fear-avoidance beliefs regarding work (FABQ-W) and physical activity (FABQ-PA) compared to patients with acute/subacute LBP (Sadeghi-Yarandi et al., 2022). In addition, evidence was found that fear avoidance belief scores at baseline predict change in functional capacity after physiotherapy treatment (Heldman, 2018). The study by Oliveira et al. (2018) shows that age at baseline influences the clinical improvement in patients with chronic non-specific low back pain. However, the association found was rather small and was not considered clinically relevant in this study. No influence of BMI at baseline was found. These results were observed after four weeks of treatment (Oliveira et al, 2018).

The objective of this clinical trial was to examine the effect of DA to physical therapy on clinical outcomes in individuals with acute LBP. Furthermore, the study aimed to provide clarity about possible factors that could influence these outcomes. Specifically, the study aimed to answer the following questions: What is the effect of DA to physical therapy on pain intensity and disability in individuals with acute low back pain?; How do individual characteristics such as BMI, age, and fear avoidance beliefs at baseline influence pain intensity and disability in individuals with acute LBP who have received physical therapy through DA? It was hypothesised that the improvement in pain intensity and disability due to physical therapy would be evident after both six weeks and three months of treatment. It was also hypothesised that a higher BMI, age, and levels of fear-avoidance beliefs at baseline would have a negative impact on the improvement in pain intensity and disability.

Methods

The study was approved by the Committee for Medical Ethics of UHasselt, with reference numbers CME2021/066 and B1152021000015.

Participants

Twenty individuals with acute LBP were included in the study. Nine participants were French-speaking and 11 were Dutch-speaking. Participants were recruited via physical therapy practices, general practitioner practices, e-mail, social media, and advertisements. Patients interested in participating were provided with the informed consent document and a set of baseline questionnaires to assess eligibility via email or regular post. The characteristics of the participants included are shown in Table 1.

Inclusion criteria

The following inclusion criteria were applied: 1) age between 18 and 65 years old, 2) non-specific LBP between the 12th rib and the buttocks, 3) pain lasting more than 24 hours but less than six weeks, 4) pain intensity of ≥ 3 on the Numeric Pain Rating Scale (NPRS) over the past 24 hours or over the past seven days (Downie et al., 1978) and/or a minimum score of 18 points on the Oswestry Disability Index (ODI, version 2.1a) (Fairbank et al., 1980).

Exclusion criteria

The following exclusion criteria were applied: 1) recent lumbar surgery (< 1 year), 2) pregnancy, 3) history of (any) treatment for the current pain episode, 4) generalized musculoskeletal pain, 5) red flags indicating specific LBP.

Table 1

Characteristics of the Study Sample

	Mean	SD
BMI (kg/m²)	26.3	3.0
Age (years)	43.5	15.8
ODI (0-100)	25.6	10.2
NPRS past 7 days (0-10)	5.3	1.9
NPRS past 24h (0-10)	6.0	1.6
FABQ - total (0-96)	29.7	15.4
FABQ - W (0-66)	12.1	11.3
FABQ - PA (0-30)	13.9	5.9
Back - PAQ (-20; +20)	1.1	4.2

Note. Abbreviations: SD: standard deviation, BMI: body mass index, ODI: Oswestry Disability Index, NPRS: Numeric Pain Rating Scale, FABQ-PA: Fear-Avoidance Beliefs Questionnaire Physical activity, Back-PAQ: Back Pain Attitude Questionnaire

Procedure

Average pain intensity during the past week (NPRS past 7 days), average pain intensity during the past 24 hours (NPRS past 24h), and disability (ODI) were assessed as clinical outcomes at baseline, at six weeks and three months after the start of the intervention. The details of the physical therapy treatments were not recorded. However, the treatments had to comply with both national (e.g. KCE) and international (e.g. NICE) guidelines for the management of LBP (Van Wambeke et al., 2017; Bernstein et al., 2017). According to the protocol, the first therapy session began with an evaluation of the patient. Passive techniques were not used as primary treatment, but were always combined with education, patient self-management and exercise therapy. To participate in the study, physical therapists needed to have a master degree in musculoskeletal physiotherapy and rehabilitation sciences and/or a postgraduate specialisation in manual therapy and/or be recognised as manual therapist through ministerial decree. In addition, they had to pass an a priori test regarding knowledge, attitudes and beliefs in relation to the national and international LBP guidelines.

Questionnaires that were administered were age, gender, BMI, NPRS, ODI, FABQ and Back-PAQ. All outcomes were assessed through questionnaires administered using the digital platform Qualtrics XM, a global software company. Regular reminders were mailed, allowing participants to complete the battery of questionnaires at the requested times.

Baseline assessment

Demographic and anthropometric information was collected on birth date, weight, height, BMI, and gender.

Fear-Avoidance Beliefs Questionnaire (FABQ)

A patient-reported questionnaire called the FABQ was used to evaluate a person's attitudes and beliefs regarding their pain and how it affects their daily activities and employment. The participant rates how much he/she agrees with each of the 16 statements on the questionnaire on a scale from 0 (completely disagree) to 6 (completely agree). Stronger fear-avoidance beliefs are indicated by higher FABQ scores. The FABQ was created as a tool to evaluate these beliefs, which have been linked to the development of chronic pain and disability (Waddell et al., 1993). The FABQ consists of two subscales, FABQ-Physical Activity (FABQ-PA) with a maximum score of 30 and FABQ-Work (FABQ-W) with a maximum score of 66. The FABQ demonstrated strong validity between FABQ and Tampa Scale for kinesiophobia, and substantial reliability in assessing fear-avoidance beliefs related to work and physical activity (Swinkels-Meewisse et al., 2003). The Dutch and French FABQ are valid instruments for measuring impairments in French-speaking patients (Chaory et al., 2004; Vendrig A et al., 1998).

Back Pain Attitude Questionnaire (Back-PAQ)

Back-PAQ is a patient-reported questionnaire aimed at identifying underlying beliefs such as fear-avoidance, catastrophising and poor outcome expectations. This test is conducted in patients with acute or chronic LBP. There are three versions of this test (10-, 20- and 34-item Back-PAQ) (Darlow et al., 2014). In this study, the 10-item Back-PAQ was administered. This shorter version is expected to be a useful outcome assessment tool, but more research is needed to make any conclusions about its validity and reliability (Darlow et al., 2014). The French Back-PAQ is a valid instrument for measuring impairments in French-speaking patients (Demoulin et al., 2017). The Dutch version of the Back-PAQ has not been validated yet, research is currently being carried out (*Back-PAQ 34 – Validatie Studie*, z.d.).

Clinical outcomes

Numeric pain Rating Scale (NPRS)

The NPRS is a patient-reported scale used to assess the pain intensity of back or leg pain. It is a simple and generally used method for patients to describe their pain. It is an 11-point scale, asking the patient to rate pain intensity from 0 to 10. Score 0 represents "no pain" and 10 represents "extreme pain" (Downie et al., 1978). In our study, the NPRS is used to represent the average pain of the past seven days (NPRS past 7 days), and also to represent the average pain of the past 24 hours (NPRS past 24 h). When compared to three other pain intensity measures, the study by Ferreira-Valente et al. (2011) prefers the NRS because of its good sensitivity, responsiveness, and simplicity.

Oswestry disability index (ODI)

A patient-reported tool for determining the degree of disability and functional impairment suffered by people with LBP is the ODI questionnaire (Fairbank et al., 1980). It is frequently employed to assess how LBP affects a person's activities and quality of life on a daily basis. Six possible responses are included for the following items: the degree of pain, self-care (cleaning, dressing), lifting, walking, sitting, standing, sleeping, social life, sex life, and travel/transportation. Score 0 indicates no limitations due to pain, while score 5 indicates high limitations due to pain. The scores of the ten questions are summed up, and multiplied by two to get a percentage score. Severity is assigned to scores: 0–20% represents minimal disability, 21–40% represents moderate disability, 41–60% represents severe disability, 61–80% represents crippling back pain and 81–100% represents patients who are either bedridden or whose symptoms are exaggerated (Fairbank et al., 1980). The ODI has been recognized as a valid and reliable measure of condition-specific disability, recommended for use in various applications related to spinal disorders (Davidson & Keating, 2005). The Dutch and French ODI are valid instruments for measuring impairments in Dutch-and French-speaking patients (van Hooff et al., 2015; Vogler et al., 2008).

Data analysis

Power analysis

Due to the limited sample size of 20 participants, statistical power was checked using the G*Power 3.1 browser. For the one-sample t-test, 't-test' was chosen with a statistical test 'Means: Difference

from constant (one sample case)'. 'Post-hoc: Compute achieved power given α, sample size, and effect size' is chosen for the type of power analysis. In addition, the effect size was calculated by using the mean of the null hypothesis and the alternative hypothesis and the standard deviation. The alpha is entered as 0.0083. For the single linear regressions, 'F-tests' was chosen with a statistical test 'Linear multiple regression: Fixed model, R^2 deviation from zero'. 'Post-hoc: compute achieved power - given α, sample size, and effect size' is chosen for the type of power analysis. In addition, the effect size was calculated by the square of the correlation coefficient. The alpha is entered as 0.00416 and the number of predictors is one. A power of 80% is considered an acceptable power. The smaller the power, the higher the probability of a type II error.

Statistical analysis

JMP Pro 17 was used for the statistical analysis. Six separate one-sample t-tests were performed to analyse the effect of physical therapy (via DA) on pain intensity and disability in individuals with acute LBP. Two difference scores were calculated for each clinical outcome (ODI, NPRS past 7 days, NPRS past 24h); based on two time periods 'scores at week 6 minus scores at baseline' and 'scores at 3 months minus scores at baseline'. A one-sample t-test was performed for each difference score. P-values indicated whether the test mean was different from 0, and thus, whether physical therapy had a significant effect on a clinical outcome (e.g. ODI) over a specific timeframe (e.g. baseline to week 6). The normality and variability of the residuals of the six difference scores were checked and approved. The initial alpha level 0.05 was adjusted using the Bonferroni correction. The value 0.05 was divided by the number of tests performed, which was six. The significance level was established at a threshold of $\alpha < 0.0083$.

Twelve simple linear regressions were performed for each clinical outcome to analyse if BMI at baseline, age at baseline, and fear-avoidance beliefs at baseline can explain a part of the variance in the difference scores of ODI, NPRS past 7 days, NPRS past 24h. P-values of parameter estimates were considered to conclude whether parameter estimates (e.g. BMI) explain the variability in clinical outcomes (e.g. ODI) over time (e.g. baseline to week 6). Normality, homoscedasticity, and linearity of the residuals were checked and approved in every single linear regression. The initial alpha level 0.05 was adjusted using the Bonferroni correction. The value 0.05 was divided by the number of tests performed, which was 12 since six independent variables were tested for each

outcome, each for two time periods. The significance level was established at a threshold of $\alpha < 0.00416$.

Results

The normality and variability of the residuals of the data were checked and approved. Six one-sample t-tests (double-sided) demonstrated that the p-values of the scores on the ODI, NPRS past 7 days, and NPRS past 24h were all significant for both timeframes (baseline to week 6, baseline to 3 months) (Table 2). All p-values were smaller than 0.0083, meaning that physical therapy via DA significantly reduced pain and disability levels after six weeks and three months of treatment.

Table 2

Changes in mean scores, standard deviations, and p-values of pain and disability over time with physical therapy intervention

	Outcomes					
	Disability (ODI)		Pain past 7 days		Pain past 24h	
	6 weeks - baseline	3 months - baseline	6 weeks -baseline	3 months - baseline	6 weeks - baseline	3 months - baseline
AE	-22.3	-20.2	-4.1	-3.8	-4.2	-3.8
SD	17	16.0	2.5	3.0	2.8	3.5
P-Value	<0.001	<0.001	<0.001	<0.001	<0.001	= 0.004

Note: Significance level $\alpha < 0.0083$. Abbreviations: SD: Standard Deviation, AE: Actual Estimate, ODI: Oswestry Disability Index, NPRS: Numeric Pain Rating Scale

Influencing factors

After the Bonferroni correction, the Back-PAQ parameter estimate for ODI was recorded as significant both at six weeks and three months, with p-values of 0.0036 and 0.004 respectively. After reducing the probability of finding false positives, it is possible to state that a significant proportion of the variability in the evolution of disability can be explained by the score on the Back-PAQ at baseline. Specifically, R-square values show that baseline Back-PAQ scores explain 42% of the variance in disability from baseline to six weeks, and 44% from baseline to three months. These results were observed within a 95% confidence interval.

If not corrected for Bonferroni, more influencing factors would be considered significant. These results have p-values between the initial threshold $\alpha < 0.05$ and the Bonferroni adjusted threshold $\alpha < 0.00416$, see Table 4 (in italics).

Table 3

Summary of p-values for independent variables influencing pain and disability over time

	Dependent variables					
	Disability (ODI)		Pain past 7 days		Pain past 24h	
	6 weeks - baseline	3 months - baseline	6 weeks - baseline	3 months - baseline	6 weeks - baseline	3 months - baseline
Independent variables						
BMI	p = 0.813	p = 0.094	p = 0.486	p = 0.738	p = 0.645	p = 0.275
Age	p = 0.809	p = 0.764	p = 0.628	p = 0.790	p = 0.620	p = 0.265
FABQ-total	p = 0.302	p = 0.264	p = 0.571	p = 0.426	*p = 0.049*	p = 0.066
FABQ-W	p = 0.604	p = 0.678	p = 0.634	p = 0.438	p = 0.394	p = 0.739
FABQ-PA	p = 0.362	p = 0.182	p = 0.956	p = 0.654	p = 0.226	*p = 0.032*
Back-PAQ	**p = 0.0036**	**p = 0.004**	*p = 0.015*	*p = 0.018*	p = 0.149	p = 0.090

Note. bold: p-values Bonferroni threshold, italics: p-values between Bonferroni threshold and 0.05. Abbreviations: ODI: Oswestry Disability Index, NPRS: Numeric Pain Rating Scale, BMI: Body mass index, FABQ-W: Fear-Avoidance Beliefs Questionnaire Work, FABQ-PA: Fear-Avoidance Beliefs Questionnaire Physical activity, Back-PAQ: Back Pain Attitude

Table 4

R-square values and confidence intervals for significant predictors of pain and disability outcomes over time

Time period	Independent variable	Outcome	R-square value	Confidence interval (95%)
Baseline to 6 weeks	Back – PAQ	Disability (ODI)	**0.4201**	[-3.31; -0.77]
		Pain past 7 days	**0.3167**	[-0.59; -0.07]
	FABQ – total	Pain past 24h	*0.2215*	[-0.18; -0.00]
Baseline to 3 months	Back – PAQ	Disability (ODI)	*0.4354*	[-4.12; -0.95]
		Pain past 7 days	*0.3204*	[-0.73; -0.08]
	FABQ – PA	Pain past 24h	*0.2712*	[-0.61; -0.03]

Note. bold: p-values Bonferroni threshold, italics: p-values between Bonferroni threshold and 0.05. Abbreviations: ODI: Oswestry Disability Index, NPRS: Numeric Pain Rating Scale, FABQ-PA: Fear-Avoidance Beliefs Questionnaire Physical activity, Back-PAQ: Back Pain Attitude Questionnaire

The power of the one-sample t-test was higher than 80% in each group (ODI, NPRS past 7 days, NPRS past 24h) for both time periods. This means that the risk of a type II error is low. Because of high power outcomes, the probability of similar outcome measures on retesting is very high. The power analysis indicated that the outcome measures of the simple linear regressions were below 80% on

Bonferroni correction $\alpha < 0.00416$, indicating a high probability of a type II error. Additionally, the probability of obtaining similar outcome measures upon retesting is very low.

Discussion

This clinical trial studied the effect of physical therapy via DA on pain and disability levels in individuals with acute LBP at six weeks and three months after the start of the intervention. Secondly, relevant factors that may influence these outcomes were examined.

As anticipated, the results obtained from our study revealed improvements in clinical outcomes at both measurement moments. Such improvement in disability was also confirmed in the study by Brooks et al. (2008), where they measured this clinical outcome using the Roland Morris Disability Questionnaire (RMQ). Indeed, they found a greater improvement in disability in patients with LBP who received physical therapy through DA compared to those who were, instead, referred by their general practitioner. In addition, Bornhöft et al. (2019) also found greater reductions in pain and disability levels in patients receiving physiotherapy through DA compared to via referral by the general practitioner. However, this study did not specifically examine acute LBP, including, more broadly, all musculoskeletal conditions instead. The studies above compared patients with a control group. The results of this trial should be interpreted with caution as no such comparison was made.

As hypothesised, the results show that a higher level of fear-avoidance beliefs at baseline does have a negative impact on the improvement in clinical outcomes. Further, Oliveira et al. (2018) found that higher age at baseline would have a negative effect on pain and functional impairment, which is consistent with the hypothesis formulated in our study, but contradictory to the results found in our study. This discrepancy in results could be explained by the fact that the participants in the study had a different age (47.1) than our study (43.5) (Oliveira et al., 2018). In addition, no evidence was found that a higher BMI at baseline would have a negative effect on pain and functional impairment (Oliveira et al., 2018). This similarity in results may be explained by the fact that the participants in the study had a similar BMI (26.8) as in our study (26.3) (Oliveira et al., 2018).

Sadeghi-Yarandi et al. (2022), though, found that higher BMI was a predictor of chronicity in non-specific LBP. This study also showed that depression, lifestyle, disability, pain intensity, sleep quality, and fear-avoidance beliefs were predictors of chronicity. It should be mentioned that in this study, physical therapy was not provided via DA, which presents a challenge when generalizing the findings to the context of our study. DA is expected to reduce the likelihood of chronicity, which has positive effects on the predictors mentioned above (Bornhoft et al, 2019). Regarding age, the results of the

study by Elliott et al. (1999) show that age is associated with chronic pain. They also observed that older people tended to report considerably more about their problems.

Several independent variables were analysed to see if they explain the variation in one dependent variable/clinical outcome. Due to the relatively small sample size, multiple single linear regressions were preferred over one multiple linear regression. However, performing multiple tests on the same group may also increase the likelihood of a type I error (Francis & Thunell, 2021). As a solution, a Bonferroni correction with $\alpha = 0.0041$ was used to correct for multiple comparisons (Francis & Thunell, 2021). A future direction for research is to include a larger sample size, which may reduce the need for a Bonferroni correction. Without this correction, the Back-PAQ parameter estimate for 'NPRS past 7 days' would be significant at both time points. Similarly, the FABQ-total parameter estimate for 'NPRS past 24h' at six weeks and the FABQ-PA parameter estimate for 'NPRS past 24h' at three months would be significant (see Table 3).

Strengths and limitations

The primary limitation of this study is the lack of comparison with a control group. In the future, it would be desirable for research to look into the comparison between DA and referral. This is necessary to assess whether DA was indeed a driving factor for the improvement in the clinical outcomes, or not.

The sample size was limited to 20 participants, resulting in low power for the simple linear regressions, which in turn might predispose to a high probability of a type II error. As a result, the probability of obtaining similar outcome measures upon retesting is very low. On the contrary, the power was considered high enough for the one-sample t-tests. Besides the small sample size, data was missing from two participants at six weeks and three months for the ODI and NPRS, and there was no outcome data available for one participant at three months for the ODI and NPRS.

The recruitment methods used in our study may have increased the possibility of selection bias. In fact, when patients are not randomly selected, but can rather apply by their own initiative via recruitment methods such as advertising, a representative sample of the research population may not be reached (Ganguli et al., 1998). In addition, the use of digital platforms to administer questionnaires already excludes a portion of the population that does not have access to such

technology. However, using a digital platform to collect data can increase the efficiency and accuracy of the collection process.

Furthermore, it has to be noted that patient-reported questionnaires may increase the possibility of measurement bias, because of differences in interpretation and responding styles among participants (Hernan & Cole, 2009). On the contrary, the questionnaires are mostly standardised measures (see method for validity and reliability).

Another notable limitation is the lack of detailed recording of the therapy session, which could introduce performance bias. This was countered by checking elements such as the physiotherapist's degree, beliefs and knowledge prior to inclusion (French et al., 2021). Moreover, the physical therapy treatments were consistent with both national and international guidelines, therefore increasing the relevance and applicability of the results.

BMI is generally used to categorise a person within a specific weight class (underweight, normal weight, overweight of obesitas) (Zierle-Ghosh & Jan, 2024). However, this measurement tool presents some limitations when interpreting results. In fact, as BMI does not differentiate between muscle mass and fat mass, it cannot be assumed that a high fat percentage influences low back pain. Despite this, in the cohort study by Brady et al. (2019) results show that a high fat percentage was associated with a significantly higher risk of back pain and disability, suggesting fat mass reduction to prevent back pain, especially in the android region.

Besides making a comparison with a control group, a second recommendation for future research would be to follow up the participants over a longer period of time. Where long-term effects and behavioral changes in patients can be evaluated in comparison to a control group. DA may lead to behavioral changes, which we would expect to persist in the long term. Based on the findings of this study, some recommendations for clinical practice can be made. Our study revealed that fear-avoidance beliefs affect rehabilitation outcomes: it is therefore important to identify and address such factors when treating people with LBP.

Conclusion

The results of this study showed that pain intensity and disability in patients with acute LBP can be improved by physical therapy through DA. This can only be concluded for short-term effects, as measurements were taken at six weeks and three months. Secondly, fear-avoidance beliefs at baseline were found to influence the evolution of pain intensity and disability, with higher baseline scores related to less improvement in clinical outcomes over time during treatment. Further research with a larger sample size and a control group is needed to generalise these conclusions.

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