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PHYSICAL PERFORMANCE, PAIN, PAIN BEHAVIOR AND SUBJECTIVE DISABILITY IN PATIENTS WITH SUBACUTE LOW BACK PAIN

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ABSTRACT. The aim of this paper was to study the physical performance, pain, pain behavior and disability in patients with subacute low back pain (LBP). The patients were blue-collar workers and had been sick-listed for 8 weeks due to subacute low back pain. A total of 103 patients were randomized, 51 of them to the intervention group and the other to a control group. Recordings of physical performance and complaints of LBP were done before and after treatment in the intervention group. The proportion of patients with no complaints of LBP was significantly greater in the intervention group than in the control group at the one-year follow-up. The patients who intra-individually improved their physical performance also intra-individually decreased their complaints of LBP. The intra-individual improvements were suggested to be important for the individual return to work.

Key words: low back pain, rehabilitation, pain, pain behavior, subjective disability, physical capacity, treatment, physical therapy.

The low back pain (LBP) dilemma is a multidimensional problem (19, 20, 21, 28). LBP usually has a benign course (20, 21, 28). Eighty percent of the patients with acute LBP recover within 6 weeks (20, 21, 28). Pain cannot be regarded as a single, homogeneous phenomenon. Pain occurs in connection with diseases or physical complaints (20, 21, 24, 28, 29). In all contacts with patients suffering from pain, the point of departure must be that all pain is real (2, 8, 13, 21, 28, 29). Pain itself is not a disease. It is a symptom (8, 11, 13, 28, 29). Pain is defined by the International Association for the Study of Pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage (24). Pain behavior should be understood as a social communication, the meaning of which remains to be discovered in the individual case (8, 11, 13). Pain behavior can automatically come under the control of learning (8, 11, 13). Patients with LBP can have difficulties distinguishing between hurt and harm (8, 11, 13). There is often a discrepancy between what patients say and what patients do (8, 11, 13, 28). Physical impairment is the objective structural limitation and subjective disability is the result of failed function (8, 13, 26, 28).

Each patient's perception of the LBP problem can, for example, be shown by low physical performance, expressed verbally as pain or subjective disability or displayed as pain behavior (7–11, 13, 24, 26–28). The patient's expressions of the problem often include complaints of pain, which then often guide the treatment (7, 10, 13). Pain reduction by analgetics and rest is not enough after the acute phase of LBP (8, 13, 20, 21, 28). Patients with LBP are not a homogeneous group, nor are their reports and experiences of LBP uniform (2, 6, 9, 11, 13–16, 20, 21, 22, 25, 27–30). Comprehensive programs for LBP patients have been implemented to restore functional capacity; few of them are randomized controlled studies (20, 21). Most of the treatment programs for LBP patients are directed to patients with chronic LBP (20, 21). Patients with LBP sick-leave for more than 6 weeks are at considerable risk of becoming chronic LBP sufferers. Early intervention programs are suggested by several researchers dealing with patients suffering from LBP (20, 21, 28).

We have earlier reported that traditional care plus an individually graded activity program is superior to traditional care (14), that mobility, strength and fitness improve significantly after treatment but are not correlated to the rate of return to work, except for abdominal muscle endurance, lifting capacity and spinal rotation (15), and also that pain behaviors predict return to work (22).

The aims of this randomized prospective controlled study were: to analyze the effect of intervention on pain, pain behavior and disability, to study the

inter-relation between pain, pain behavior and disability, to study the intra-individual improvements of pain, pain behavior and disability, to compare the pretreatment recordings of physical performance and complaints of LBP and to analyze the effect of the intervention program by comparing the intervention group with the control group.

The study was approved by the Ethics Committee of the Medical Faculty of the University of Göteborg, Sweden.

MATERIAL AND METHODS

Patients

The patients had to fulfil three inclusion criteria to be referred to the prerandomization examination: *i*) blue-collar workers, *ii*) sick-listed for 6 weeks because of any LBP diagnosis and *iii*) no sick-leave because of any LBP diagnosis during a period of 12 weeks before the current sick-listing episode.

All patients were medically examined by an orthopedic surgeon and psychosocially evaluated by a social worker before randomization. The medical examination excluded roughly 25% of the referred patients because of *i*) herniated disc, spondylolisthesis, spinal stenosis and instability, where surgery was indicated, *ii*) earlier back surgery, vertebral fractures, and tumors of the spine, *iii*) inflammatory disease, *iv*) pregnancy, *v*) major medical disease, *vi*) major psychiatric disease, or *vii*) drug addiction or alcoholism. The psychosocial screening did not exclude any patients. Age, lumbar range of motion, finger-floor distance, modified Schober, pain, pain behavior, subjective disability and physical work demands did not differ significantly between the groups (14, 15, 16).

After 8 weeks of sick-leave, all referred patients ($n = 103$) suffering from benign LBP were randomized either to the intervention group (39 men, 12 women) or to the control group (32 men, 20 women). Two patients allotted to the intervention group and 3 in the control group refused to participate (14). Seventy-five percent of the patients were immigrants from 13 different countries. The immigrant patients did not have to speak Swedish. Properly translated forms of each native language were available. The patients were on average 41 years old (SD 11 yrs, Range 19–64 yrs).

All patients in both the intervention and control groups were continuously and traditionally cared for by their regular physicians, not by the orthopedic surgeon (CÖ) in the study, before, during and after the intervention. The forms of sick-listing and the time of return to work for the patients in both groups were at the discretion of their regular physicians. After the pre-randomization examination, the patients in the control group were given the traditional care recommended by their physicians, general rest, analgetics and prescription of unspecific physical treatment modalities (19, 21). The patients in the control group were not prevented from getting information from the patients in the intervention program. All physicians concerned agreed to have their patients allotted to the intervention program, under the guidance of the physical therapist (IL). The physicians who were responsible for the patients in the intervention program were informed by the physical therapist of their patients' progress.

Measurements of complaints of LBP

The complaints of LBP were measured as pain, pain behavior and subjective disability. The perceived pain was measured with a category scale with ratio properties (Appendix I) developed by Borg (4). Pain behavior was observed and rated with the 10-item University of Alabahma at Birmingham (UAB) pain behavior scale (Appendix II) developed by Richards et al. (23). Subjective disability was recorded with the subjective disability index (Appendix III) developed by Waddell & Main (26).

Measurements of physical capacity

Physical capacity (i.e. mobility, strength and fitness) was measured by currently used methods (15). Backward and lateral bending was measured according to the procedure of Frost et al. (12). Spinal rotation was measured using a procedure modified from that of Mellin (18). The lumbar range of motion (ROM) in forward-backward bending was measured with a kyphometer, as described by Debrunner (5). Forward bending was measured by the finger-floor test and the modified Schober test (3). Active leg raising was measured with the patient lying supine and the patient lifting one leg, using a pre-drawn wall goniometer (18). Back muscle endurance time (in seconds) was measured with a stopwatch using a procedure modified by Biering-Sörensen (3). Abdominal muscle endurance time (in seconds) was also measured with a stopwatch with the patient in a partial sit-up position using a procedure modified after McQuade et al. (17). The ability to walk, to perform deep knee bends unilaterally and bilaterally, to climb onto a 25 cm high stool and jump from the stool, to squat and to stand tiptoe with elevated arms was recorded (1 = without difficulty, 2 = with some difficulty, and 3 = cannot manage). The paitent's pulling down capacity (in kilograms) with the arm in 90° of elevation was tested with a wall-attached dynamometer. Pulling and pushing were tested with a vehicle loaded with 100 kg of weights. Lifting-to-tolerance capacity was tested with a simple box-lifting test. A work test were performed on a stationary bicycle with a fitness computer (1). The results of mobility, strength and fitness recordings have been presented in detail earlier (15).

The intervention program

The purposes of the intervention program were to restore occupational function and to facilitate return to the previous non-modified work-place (14, 15, 16). The end-point of the program was the individual return to work. The patients were not obliged to stay in the program for a specific number of weeks.

The intervention program, conducted by a physical therapist, consisted of the following parts: *i*) Measurements of physical capacity were made to measure the current level of functional capacity within each patient. The measurements showed the patient that he or she was able to perform physical capacity tests. The measurements were also used to give each patient feedback on gained function during the exercise program. *ii*) Measurements of complaints of LBP were initially obtained to be used for positive reinforcement of each patient's gained function. *iii*) A work-place visit made it possible to investigate each patient's physical work demands, which was determinant of the individually graded exercise program. *iv*) A modified version of the Swedish Back School was individually taught. The information was based on ability, not on LBP disability (i.e. only positive

reinforcing information was included). *v*) The individually graded exercise program with a behavioral therapy approach was based on individual capacity and individual physical work demands. As pertains to exercises, the essentials of the operant conditioning approach are to develop an individually graded exercise program to teach the patient that it is safe to move while also increasing his or her activity level. Fordyce's model of exercise to quota, not to pain, was used (8). The individually graded exercises were set to quota (i.e. the patients did not stop the exercise because of pain or other tolerance factors, as the quota was always set below tolerance). Exercises were selected. A small number of initial baseline trials was carried out in which the patient exercises to the limit of tolerance. Detailed performance records are kept during these baseline trials. The therapist then sets quotas of exercises to be performed in each trial based on the patient's baseline levels. Initial quotas are lower than the baseline levels (e.g. 50–75% of baseline levels), but are systematically increased. Quotas were set for frequencies, loads, laps, repetitions, and endurance time for each exercise. Each patient performed his or her individually graded exercise program 3 days a week until his or her return to work. The physical therapist gave continuous positive reinforcement for performed quotas and increased functional capacity. The physiotherapist observed and recorded each patient's complaints of LBP, but made no attempt to change the program in response to such display. The patient's return to his or her previous nonmodified workplace was the goal of the individually graded exercise program (14, 15, 16).

Sick-leave

In Sweden, all employees who are absent from work because of illness receive a sickness allowance, which, during the investigation years, was 90% of their income. The law does not allow anyone to be fired because of illness. Thus, all patients were entitled to return to their regular job after the end of sick-leave.

The sick-leave data for each patient (100%) were obtained from the Social Insurance Office for 3 years (1 year before, during the intervention year and 1 year after the intervention year). The investigators were blinded to the sick-leave data until 2 years after the intervention.

Evaluation procedure

The physical therapists' aim when recording complaints of LBP and physical performance was to set a baseline for the intervention program. Recordings of physical performance and complaints of LBP were performed before and after treatment in the intervention group. At the one-year follow-up, the recordings were done in both groups. The evaluation included 98 to 103 randomized patients, 49 of them in the intervention group. Four of the drop-out patients returned to their regular jobs after 13, 15, 29 and 59 days, respectively. The fifth patient (a man) was granted a permanent disability pension (14).

Statistics

The Statistical Analysis System (SAS) for computers was used in all analyses. Fisher's exact probability test was used to compare dichotomous data, e.g. proportions of patients with and without complaints of LBP in both groups. The paired *t*-test for difference was used to compare the change between pre- and post-treatment recordings in the intervention group. The Spearman rank-order correlation was used for comparison of the recordings of physical performance and complaints of LBP in the intervention group.

The *t*-test was used to compare the one-year follow-up recordings in the intervention and control group. Thus, the influence of the time recovery effect was assumed to be controlled for, as patients with LBP recover over time.

Different statistical methods (e.g. *i*) comparing the proportion of patients with and without complaints of LBP, and *ii*) comparing the change of complaints of LBP) were used when analyzing the complaints of LBP recordings for two reasons: First, an effect of intervention was obtained if the patients became free from complaints of LBP; secondly, an effect of intervention was obtained if the patients intra-individually decreased their complaints of LBP.

A decrease of complaints of LBP and an increase of the physical performance recordings in the intervention group was to be expected according to the content of the intervention (14). A significant decrease of at least one of the recordings of complaints of LBP was expected if the pre-treatment recordings were >0. A significant increase of at least one of the recordings of physical performance was expected. Since no normal values exist for LBP patients, all recordings were included in the analysis.

The correlation between the rate of return to work and the amount of sick-leave during the second follow-up year and the complaints of LBP was analyzed with the Spearman rank-order correlation.

A significance level of $p \leq 0.01$ was chosen since in studies with many comparisons p-values >0.01 can be regarded as trends.

RESULTS

Complaints of LBP

Improvement after treatment. The intervention program reduced the complaints of LBP. The proportion of patients with complaints of LBP (i.e. pain, pain behavior or subjective disability) was significantly ($p \leq 0.01$) larger before than after treatment (Fig. 1).

The recordings of pain, pain behavior and subjective disability were intra-individually lower than before treatment (Table I).

A large proportion of patients (80%) intra-individually decreased their pain or had no pain before treatment. Seventy-nine percent of the patients intra-individually decreased their pain behavior or had no pain behavior before treatment. The subjective disability was intra-individually decreased or zero before treatment in 73% of the patients.

Inter-correlation of complaints of LBP. The pre-treatment recordings of complaints of LBP in the intervention group were significantly inter-correlated. For example, patients who reported more

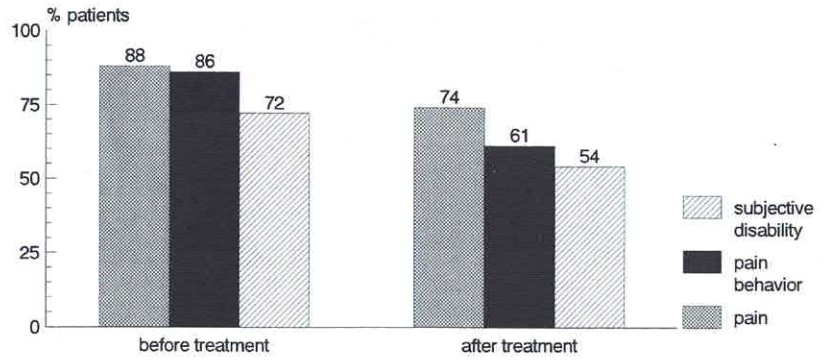

Fig. 1. Proportion of patients with complaints of LBP before and after treatment in the intervention group ($n = 49$). The proportions of patients with complaints were significantly ($p \leq 0.01$) smaller after treatment.

pain also displayed more pain behaviors as well as more subjective disability (Table II).

Physical performance

The patients in the intervention group increased their physical performance during the intervention program. In the intervention group, the recordings of physical performance were significantly higher after treatment than before treatment, as earlier reported (15). The recordings of physical performance were also significantly higher in the intervention group than in the control group at the one-year follow-up (15).

Comparison of physical performance and complaints of LBP

The pretreatment recordings in the intervention group of *mobility* and *strength*, but not *fitness*, were significantly correlated to the pretreatment recordings of complaints of LBP (Table III). The recordings of complaints of LBP were lower if the recordings of physical performance were higher. The finger-floor distance, jumping and squat lifting recordings were inter-correlated to pain and pain behavior as well as to subjective disability. The subjective disability index was correlated to a larger number of mobility and strength recordings than were the pain and pain behavior recordings.

The intra-individual improvements

A large proportion of patients (83%) in the intervention group intra-individually improved in at least one of their complaint recordings after the intervention program.

Seventy-four percent of the patients in the intervention group intra-individually improved in at least one of their recordings of physical capacity after the intervention program.

Intra-individual improvement in both the complaint recordings and physical capacity recordings was found in 74% of the patients.

Correlation between complaints of LBP and sick-leave

The rate of return to work was in the intervention group correlated to the pre-randomization measurements of pain ($r = 0.57$, $p \leq = 0.01$), pain behavior

Table I. *The mean and SD of pain, pain behavior and subjective disability before and after treatment in the intervention group ($n = 49$)*

The paired t-test showed a significant intra-individual decrease between before and after treatment

	Before treatment		After treatment		
	Mean	SD	Mean	SD	p
Pain	3.3	2.0	2.4	2.1	≤ 0.01
Pain behavior	2.3	1.7	1.5	1.9	≤ 0.01
Subjective disability	2.4	2.2	1.5	1.9	≤ 0.01

Table II. *The significant ($p \leq 0.01$) inter-correlation (r) of pretreatment recordings of complaints of LBP in the intervention group ($n = 49$)*

	Pain	Pain behavior
Pain behavior	0.64	
Subjective disability	0.52	0.74

Table III. *The significant ($p \leq 0.01$) correlations between pretreatment recordings of mobility, strength and fitness and pretreatment recordings of pain, pain behavior and subjective disability in the intervention group ($n = 49$)*

The significant ($p \leq 0.01$) correlations mean that lower physical performance was correlated to higher complaints of LBP, regardless of the direction of the correlation coefficient. The direction of the coefficient (r) is connected with the recording procedure

	Pain	Pain behavior	Subjective disability
Mobility			
Finger-floor	0.46	0.42	0.53
Mod. Schober	–	–	−0.42
Backward bending	–	–	–
Lumbar range of motion (ROM)	−0.40	–	−0.54
Lateral bending	–	–	–
Spinal rotation	−0.44	–	−0.60
Active leg lift	–	–	−0.40
Walking	–	–	–
Kneeling	–	–	–
Climbing	–	–	–
Jumping	0.43	0.51	0.53
Squatting	–	–	0.45
Tip-toe	–	–	–
Strength			
Arm strength	–	−0.38	−0.41
Abdominal muscles	–	–	−0.44
Back muscles	–	–	–
Pulling	–	–	–
Pushing	–	–	–
Squat Lifting	−0.42	−0.46	−0.62
Fitness	–	–	–

($r = 0.54$, $p \leq = 0.01$) and subjective disability ($r = 0.57$, $p \leq = 0.01$). Thus, the more complaints of LBP, the more sick-leave before return to work. The amount of sick-leave during the second follow-up year was correlated to the pretreatment recordings of pain ($r = 0.52$, $p \leq = 0.01$), pain behavior ($r = 0.68$, $p \leq = 0.01$) and subjective disability ($r = 0.52$, $p \leq = 0.01$). Thus, the more complaints of LBP the more sick-leave during the second follow-up year.

Table IV. *The mean and SD of pain, pain behavior and subjective disability at the 1-year follow-up in the intervention group ($n = 49$) and control group ($n = 49$)*

The two-sample t-test showed a significant difference between the groups for subjective disability

	1-year follow-up				
	Intervention group		Control group		
	Mean	SD	Mean	SD	p
Pain	2.1	2.4	3.0	2.4	NS
Pain behavior	1.0	1.4	1.4	1.5	NS
Subjective disability	0.8	1.6	2.0	2.3	≤ 0.01

NS = not significant $p > 0.01$.

Effect of intervention

The proportion of patients who reported complaints of LBP was significantly larger ($p \leq 0.01$) in the control group than in the intervention group at the one-year follow-up (Fig. 2).

The average scores for complaints of LBP were higher in the control group than in the intervention group at the one-year follow-up, but significantly ($p \leq 0.01$) so for subjective disability only (Table IV).

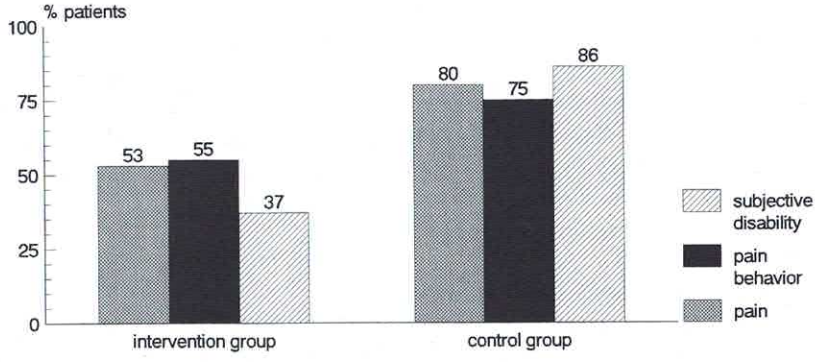

Fig. 2. The proportion of patients with complaints at the 1-year follow-up was significantly ($p \leq 0.01$) smaller in the intervention group than in the control group ($n = 49$, $n = 49$).

DISCUSSION

In this controlled study, all patients were sick-listed for 6 weeks when they entered the prerandomization examination. The randomized patients were still on sick-leave at week 8. Complaints of LBP, i.e. pain, pain behavior and subjective disability, initially occurred in a large proportion of the patients, but not in all. The complaints of LBP could be regarded as one of the motives for sick-listing and physical capacity as another.

Many patients complained or displayed signs of LBP when they returned to work, which was the endpoint of the intervention program. However, most patients intra-individually improved their scores for complaints of LBP as well as their physical capacity before returning to work. Thus, not all patients were necessarily free from complaints of LBP when they returned to work. This may imply that most patients intra-individually need to decrease their complaints of LBP and increase their physical capacity before return to work. The individual scores of complaint measurements were not the most important factor since the intra-individual decrease of complaints of LBP was of greater importance.

The average scores for complaints of LBP recordings at group level were not used to decide the individual return to work. The individual score must take into account the fact that some patients are "high" raters and others are "low" raters. Cultural differences influencing "high/low" raters must be considered in this study with patients from 13 different countries. The average score does not take into account cultural or ethnic differences. The intensity and the change of complaints of LBP are always intra-individual. This indicates that the intra-individual reduction of complaints of LBP is more important than the intensity of the complaints, as others also have found (2, 8, 13, 25, 28, 29, 30).

The proportion of patients with no complaints of LBP was significantly greater in the intervention group at the one-year follow-up than in the control group, i.e. there was an intervention effect, not only a time recovery effect (29). The intervention program successfully intra-individually decreased the subjects' complaints of LBP.

The mobility, strength and fitness average recordings were also found to increase more than can be explained by a time recovery effect, i.e. there was an intervention effect (15, 29). The increase of the numbers of physical capacity recordings was also an objective of the intervention program and of great importance for the individual return to work. The intervention program also successfully intra-individually increased the subjects' physical capacity (15).

The pretreatment mobility and strength recordings, but not the fitness recordings, were significantly correlated to the complaints of LBP. Other reports (6, 17, 28) have also shown this correlation between complaints and physical capacity. However, most of the authors have compared reported complaints with reported physical capacity, not with observed recordings of physical performance.

The pretreatment recordings of complaints of LBP were correlated to the rate of return to work and to the amount of sick-leave during the second follow-up year, which indicates that the score of complaints of LBP influences the recovery process.

The patients who intra-individually improved their physical performance also intra-individually decreased their complaints of LBP, as also reported in some other studies (7, 11, 13, 19, 20, 21, 28). Patients who do more also complain less of LBP (7, 8, 11, 13, 28). Both the physical performance and the complaints of LBP must be taken into account when deciding whether the patient is ready to return to work. Thus, the intra-individual improvement is suggested to be important both for complaints of LBP and physical performance in patients with subacute LBP. We therefore recommend simple recordings of physical performance, pain, pain behavior and subjective disability for patients with subacute LBP in any vocational rehabilitation program.

CONCLUSIONS

The intervention significantly reduced the patients' intra-individual complaints of LBP and increased their intra-individual physical performance. Another effect of the intervention program was that more patients in the intervention group than in the control group were free from complaints of LBP. The intervention program was successful for patients with subacute LBP.

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Appendix I

Borg's category ratio scale (4)

0	nothing at all	
0.5	very weak	(just noticeable)
1	very weak	
2	weak	(light)
3	moderate	
4	somewhat strong	
5	strong	(heavy)
6		
7	very strong	
8		
9		
10	very strong	(almost max)

maximal

Appendix II

The UAB pain behavior scale according to Richards et al. (23)

1 Vocal complaints: Verbal
2 Vocal complaints: Non-Verbal
3 Down time
4 Facial grimaces
5 Standing postures
6 Mobility
7 Body language
8 Use of visible supportive equipment
9 Stationary movement
10 Medication

Appendix III

Waddell's subjective disability index (26)

1 Heavy lifting
2 Ability to sit one-half hour
3 Ability to travel one-half hour
4 Ability to stand one-half hour
5 Ability to walk one-half hour
6 Sleep disturbance
7 Social life restriction
8 Sex life restriction
9 Help with footwear