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# DISABILITY, PAIN, PSYCHOLOGICAL FACTORS AND PHYSICAL PERFORMANCE IN HEALTHY CONTROLS, PATIENTS WITH SUB-ACUTE AND CHRONIC LOW BACK PAIN: A CASE-CONTROL STUDY

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***Objective:*** **To compare measures of disability, psychological factors, pain and physical performance in healthy controls, and patients with sub-acute and chronic low back pain. To evaluate the concept of the deconditioning syndrome and to explore factors that may contribute to chronicity.**

***Design:*** **Case-control study.**

***Subjects:*** **Three age- and gender-matched groups were included in the study; healthy controls ($n = 45$), patients sick-listed 8–12 weeks ($n = 46$) and patients with chronic low back pain on a waiting list for lumbar instrumented fusion ($n = 45$).**

***Methods:*** **Measures of disability, pain, psychological factors, and physical performance were obtained from the 3 groups using validated measures.**

***Results:*** **Gender, age, body weight and height were not significantly different between the groups. Comparable scores were found for self-rated working ability, fear-avoidance beliefs for physical activity and aerobic capacity in the 2 patient groups. Oswestry Disability Index, pain, emotional distress, abdominal and back muscle endurance were significantly different between the 3 groups. Self-efficacy for pain and fear-avoidance beliefs for work was significantly different between the 2 patient groups.**

***Conclusion:*** **The results suggest a stepwise deterioration of impairment and disability from healthy controls to patients with chronic low back pain. Most variables distinguished between healthy controls and patients with sub-acute or chronic low back pain. Deconditioning was more related to psychophysical measures of abdominal and back muscle endurance than to cardiovascular fitness. Comparable scores for fear-avoidance and working ability in the 2 patient categories suggest that these factors appear at an early stage and contribute to the transition from acute to chronic low back pain.**

*Key words:* low back pain, healthy controls, sub-acute, chronic, fear-avoidance beliefs, physical performance.

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## INTRODUCTION

Low back pain is a common complaint and its 1-year prevalence was 53% in a Norwegian epidemiological study (1). A Danish study reported that the lifetime, 1-year and point-prevalence of low back pain in the adult population was reduced in persons who are physically active at least 3 hours a week, compared with those who are less active (2).

Deconditioning is thought to be both a cause and a consequence of low back pain. The hypothesis of the deconditioning syndrome as a factor contributing to the chronicity of low back pain forms the basis for intensive physical rehabilitation of patients with chronic low back pain (CLBP). A recent study reported comparable levels of aerobic fitness in patients with CLBP, and therefore questioned the deconditioning myth. Moreover, they reported that there is no association between pain intensity and aerobic fitness. They concluded that deconditioning, defined as a lack of cardiovascular fitness levels normal for age and gender, therefore does not contribute to pain intensity in patients with CLBP (3).

Recent evidence suggests that psychosocial factors are important in predicting patients who will progress from an acute to a chronic stage. Patients with chronic pain often demonstrate somatization, anxiety and depression (4). Fear-avoidance beliefs have been hypothesized as the most important psychosocial factor in predicting disability among patients with CLBP. The cognitive-behaviour concept of how a chronic pain problem develops suggests that fear-avoidance behaviour appears at an early stage. A model for exaggerated pain perception was developed by Lethem et al. to explain why some individuals with acute pain develop chronic pain while others recover (5). This model proposes that the patients fear of pain, and subsequent avoidance behaviour, are determined by the relation between sensory and emotional components of pain. The cognitive model hypothesizes a vicious circle in which the patients beliefs and fears concerning symptoms and activity lead to unhelpful ways of managing symptoms, including avoidance behaviours, activity restriction and depression, that in turn lead to deconditioning which reflects a state of no condition or not feeling well.

The aim of the present study was to compare measures of disability, psychological factors, pain and physical performance in healthy controls, and patients with sub-acute and chronic low back pain. In addition, we wanted to evaluate the concept of the deconditioning syndrome and to explore factors that may contribute to chronicity.

## METHODS

Three age- and gender matched groups were included in the study; healthy controls ($n = 45$), patients sick-listed for low back pain 8–12 weeks ($n = 46$) and patients with CLBP on a waiting list for lumbar instrumented fusion ($n = 45$). Patients were matched for gender and age using 4 age cohorts (18–35 years, 36–45 years, 46–55 years and 55–67 years).

The control group included health workers who had not visited a physician, chiropractor or physiotherapist for back pain within the last 3 months. This group included physicians, nurses, nurse aids, secretaries, maintenance workers, cleaning and kitchen staff.

Patients in the sub-acute group had been sick-listed for 8–12 weeks due to non-specific LBP before inclusion. They were excluded if they had previous back surgery and had participated in regular physical exercise more than 3 times per week for the last 6 months. A more detailed description of these patients has been given previously (6).

Fifty-four percent ($n = 24$) of the patients on the waiting list had previous back surgery, while none of the participants in the other groups had been operated upon. The patients on the waiting list were labelled with the following diagnoses: facet joint syndrome (5 patients), spondylolisthesis (4 patients), spinal stenosis (7 patients), postlaminectomy or failed back surgery syndrome (24 patients) and degenerative disc disease (5 patients). Eighty percent ($n = 36$) were sick-listed or on disability pension (7).

### *Measures*

*Demographics.* Background variables, including age, gender, height, weight, diagnosis, sick leave and physical activity, were recorded.

*Pain.* The participants scored their pain intensity on activity and at night on 9-point scales where 1 = no pain and 9 = worst pain (8).

*Psychological factors.* Fear-avoidance beliefs. Waddel's Fear-Avoidance Belief Questionnaire (FABQ) was used, higher numbers indicating increased levels of fear-avoidance beliefs (9). The questionnaire is divided into subscales for physical activity (FABQ-PA) and work (FABQ-W).

Self-efficacy beliefs for pain. Beliefs were assessed using 4 questions about how the patient believed he/she could manage pain, i.e. "Do you believe you can reduce your symptoms by your-self" (10). A high score indicates that the patient believed he/she was able to manage pain.

Emotional distress. Symptoms were rated by the short version of the Hopkins Symptom Check List (HSCL-25) (11). Patients rate 25 symptoms from 1 (not at all) to 4 (extremely). A mean symptom score of 1.75 or more was found in 20% of women and 9% of men in a large Norwegian epidemiological study (12). A score $>1.75$ is a high predictor of current help-seeking, but seems to reflect illness or non-specific distress more than psychiatric diagnoses (13).

Life satisfaction was estimated by Cantrils Ladder Scale, a 10-point vertical numerical rating scale where 1 = very dissatisfied and 10 = very satisfied (14).

*Disability.* A Norwegian version of the original Oswestry Disability Index (ODI) (version 1.0) was used to evaluate condition-specific disability and pain (15, 16). This score has 10 questions about pain and pain-related disability in activities of daily life and social participation. Each question has 6 different response alternatives. The sum is calculated and presented as a percentage, where 0% represents no pain and disability and 100% represents the worst possible pain and disability.

*Self-rated work capacity.* Because most of the patients were out of work, a single question was used to assess the perceived capacity for work including paid work and housework. The response alternatives was graded: 1 = no limitations; 2 = some limitations, but able to do my ordinary work; 3 = periods not able to do my ordinary work; 4 = not able to do my ordinary work; and 5 = hardly self-reliant.

*Physical performance.* Cardiovascular fitness. Estimated by a submaximal bicycle ergometer test according to the method described by Aastrand (17).

Abdominal muscle endurance. Dynamic strength endurance of the abdominal muscles was measured with the patient in the supine position, knees bent at a 90° angle and with unsupported feet flat at the surface. With straight arms, a slow curl-up was performed until the fingertips just touched the proximal border of each patella. A metronome was set to 80 beats per minute and subjects took 2 beats to curl up and 2 beats to curl down (i.e. 20 curl-ups per minute). Performance with jerks or heels rise from the surface was not accepted. A maximum limit of 120 curl-ups was set (18, 19).

Table I. *Mean (SD) characteristics of the participants*

| | Control ($n = 45$) | Sub-acute ($n = 46$) | Chronic ($n = 45$) |
|---|---|---|---|
| Age (years) | 45.7 (8.1) | 44.9 (9.2) | 47.2 (10.2) |
| Gender (men/women) | 21/24 | 22/26 | 21/24 |
| Body weight (kg) | 74.5 (10.8) | 77.7 (16.2) | 75.6 (15.7) |
| Height (cm) | 173.8 (10.8) | 173.0 (16.2) | 172.0 (15.7) |

Back muscle endurance. Isometric endurance of trunk extensors was evaluated by measuring how many seconds (maximum 240 seconds) the patient was able to maintain the unsupported upper part of the body horizontal, when placed prone on a couch with legs fixed and the arms along the trunk. This modification of the Biering-Sørensen test is used in a former study of patients sick-listed for sub-acute LBP (20).

### *Statistical analysis*

The non-parametric Kruskal-Wallis one-way analysis of variance rank test and the Mann-Whitney rank sum test were applied to compare the groups. To protect against Type 1 errors while performing a lot of different comparisons, the level of significance was set to 0.01 (21). Multiple linear regression was used to adjust for the influence of pain and psychological impairment on physical performance (22, 23).

## RESULTS

Characteristics of the patients are given in Table I. Gender, age, body weight and height were not significantly different between the groups. Self-rated working capacity ($p = 0.3$) and fear-avoidance (FABQ-PA) ($p = 0.7$) were not significantly different between patients with sub-acute and chronic pain (Table II). When adjusted for pain and emotional distress, group explained less than 1% of the variance in aerobic capacity and the difference between patient groups was not significant ($p = 0.60$). Entering fear-avoidance (FABQ-PA) into the model and excluding the healthy controls from the model did not change results. Pain was not significantly associated with cardiovascular endurance. When adjusted for pain and emotional distress, group explained 27% of the variance in back muscle endurance and 21% of the variance in abdominal muscle endurance and differences between groups were significant ($p < 0.001$). All other outcome measures were significantly different between the 3 groups, demonstrating a stepwise increase in psychological impairment and disability, and a decrease in physical performance (Table II). Figure 1 shows separate box-plots in men and women for all outcome variables in the 3 groups.

## DISCUSSION

We found a stepwise deterioration of pain, disability, psychological factors and physical performance from healthy controls to patients with CLBP. All the measures used except aerobic

Table II. *Mean (SD) results of the participants*

| | Control ($n = 45$) | Sub-acute ($n = 46$) | Chronic ($n = 45$) | *p*-value for differences |
|---|---|---|---|---|
| Oswestry Disability Index | 1.6 (3.5) | 25.2 (12.2) | 43.5 (13.3) | Co-S: <0.001<br>Co-Chr: <0.001<br>S-Chr: <0.001 |
| Pain on activity | 1.1 (0.4) | 4.9 (1.9) | 6.3 (1.9) | Co-S: <0.001<br>Co-Chr: <0.001<br>S-Chr: 0.002 |
| Pain at rest | 1.0 (0.4) | 2.9 (1.9) | 5.2 (2.2) | Co-S: <0.001<br>Co-Chr: <0.001<br>S-Chr: <0.001 |
| Self-efficacy for pain | | 4.4 (1.4) | 3.5 (1.5) | S-Chr: 0.004 |
| Emotional distress | 1.2 (0.2) | 1.4 (0.4) | 1.8 (0.6) | Co-S: <0.001<br>Co-Chr: <0.001<br>S-Chr: <0.001 |
| Life satisfaction | 8.3 (1.7) | 6.8 (2.0) | 5.0 (1.9) | Co-S: <0.001<br>Co-Chr: <0.001<br>S-Chr: <0.001 |
| Fear-avoidance physical activity | | 3.4 (1.2) | 3.3 (1.5) | S-Chr: 0.73 |
| Fear-avoidance work | | 3.4 (1.3) | 4.4 (1.6) | S-Chr: <0.001 |
| Self-rated work capacity | 1.0 (0.3) | 2.5 (0.9) | 2.7 (1.0) | S-Chr: 0.30 |
| Aerobic endurance ($VO_2$/mlkg) | 34.7 (9.0) | 30.7 (5.8) | 31.8 (8.6) | Co-S: 0.004<br>Co-Chr: 0.06<br>S-Chr: 0.63 |
| Abdominal muscle endurance (number of sit-ups) | 35 (12) | 27 (16) | 19 (11) | Co-S: <0.001<br>Co-Chr: 0.002<br>S-Chr: 0.008 |
| Back muscle endurance (seconds) | 110 (49) | 77 (40) | 46 (42) | Co-S: 0.002<br>Co-Chr: <0.001<br>S-Chr: <0.001 |

endurance, fear-avoidance beliefs for physical activity and self-reported disability were able to distinguish between groups.

Cardiovascular fitness was not significantly different between healthy controls and patients with CLBP. Scores for fear-avoidance beliefs for physical activity and self-reported disability were comparable in patients with sub-acute and CLBP. Our results suggest that physical performance is just one component of the deconditioning syndrome, and that the concept may be misleading if interpreted as a reduction in cardiovascular fitness.

The hypothesis of the deconditioning syndrome as a factor contributing to chronicity forms the basis of intensive physical rehabilitation for CLBP (24). Deconditioning is thought to be both a cause and a consequence of back pain. In agreement with Wittink et al. we found no association between pain and aerobic endurance (3). In addition, the differences between groups are within measurement error for the Aastrand test (25). The small differences between groups observed for cardiovascular fitness does not mean that exercises and physical fitness training are unhelpful for patients with CLBP. Physical exercise was ranked as the most important element in a comprehensive treatment programme in patients with depression, but non-aerobic forms were as effective as aerobic forms of exercise in the treatment of anxiety disorders and depression (26, 27). The reduction in psychological symptoms following exercises observed in these studies, and in recently published studies in patients with sub-acute and CLBP, are most probably mediated by psychological mechanisms, such as distraction and mastering (6, 27, 28).

A recent British study suggested that patients who have back pain for more than 3 months may require referral to psychological services (29). In keeping with previous studies we found considerably elevated scores for emotional distress in CLBP (4, 13, 30). In the sub-acute group mean scores for emotional distress were moderately elevated. The most important psychological finding in this group was the high scores on fear-avoidance for physical activity.

A large British survey suggested that the rises in outpatient attendance and sickness absence for low back pain are not explained by a greater incidence of severe back disease (31). They observed a change in back pain over the last decade that does not greatly impair function and suggested that a cultural shift may have rendered back pain more acceptable as a reason for absence attributed to sickness. The results from the British survey suggest that the rises in outpatient attendance and sickness absence may be attributed advice given by physicians, physiotherapists and others. Thus, the high scores for fear-avoidance of patients with sub-acute pain in the present study may reflect advice given in the acute phase and suggest that they believe that they should restrict physical activity to protect themselves from injury and chronic back pain. Although fear-avoidance is a natural psychological reaction in patients with acute back pain, prolonged avoidance is an example of maladaptive behaviour.

Fear-avoidance beliefs were not assessed in the healthy controls. According to current models personality traits and experiences pre-dating the onset of pain largely determine fear of pain and avoidance behaviour (32). Nevertheless, we considered that measures of fear-avoidance in the absence of

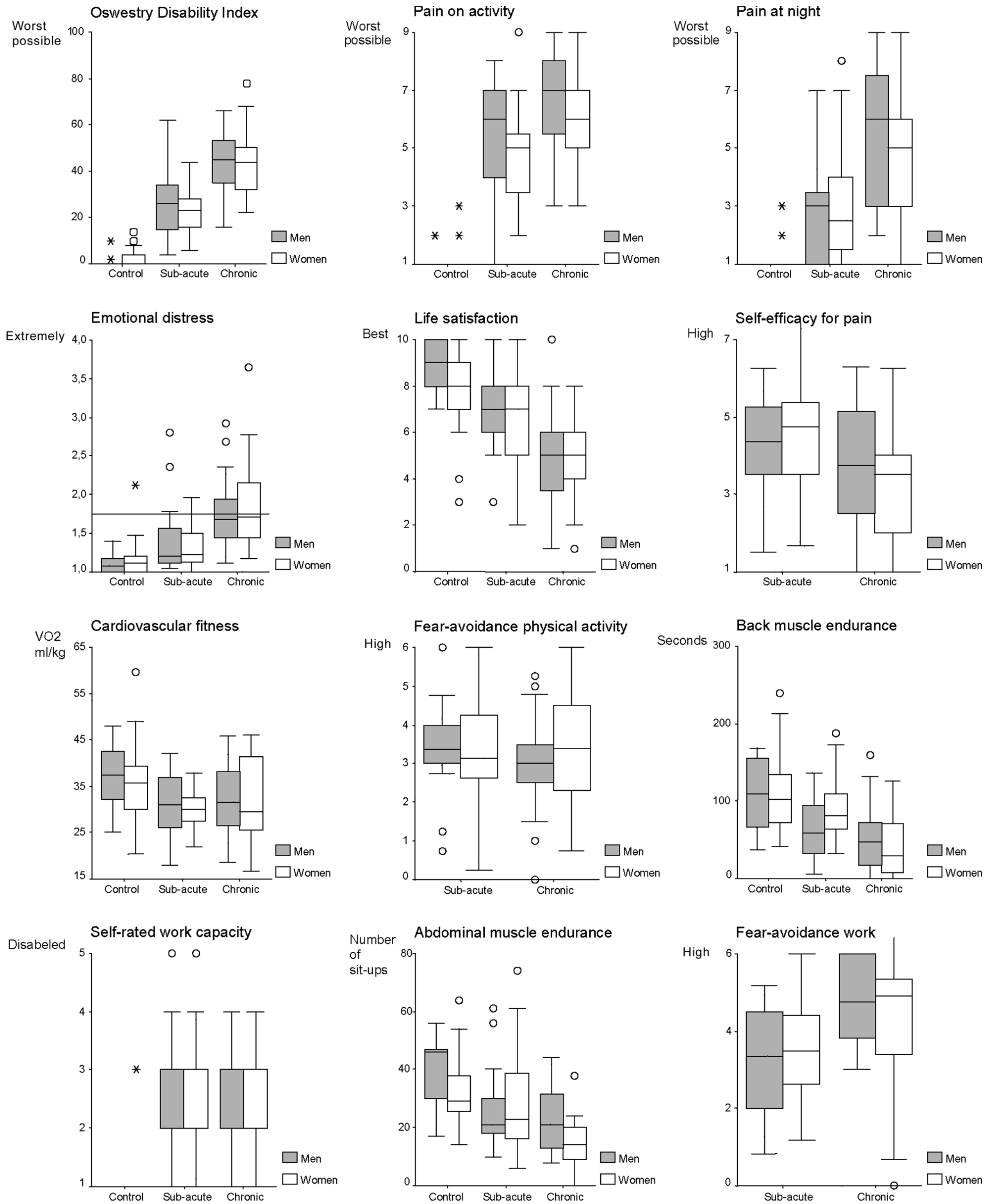


*Fig. 1.* Box-and-whisker plots of outcome variables for men and women in the 3 groups. Boxes show the median, 25th and 75th percentiles, whiskers show the values that are not outliers.

pain would be doubtful and did not use these questions in the healthy controls. Recent studies have reported elevated scores in patients with acute low back pain, and that fear-avoidance believes predicts future disability (33, 34). If fear-avoidance beliefs are present from the initial experience of LBP, and represent detriment to recovery, interventions in the acute or sub-acute stage may be useful in reducing fear-avoidance and promoting return to normal activity. A recently published clinical trial in patients with acute low back pain showed promising results in patients assigned to receive fear-avoidance based physiotherapy (35). In previously published clinical trials we have reported that cognitive intervention and exercises effectively reduced FABQ (PA) in patients with subacute and CLBP (6, 28).

A limitation of the present study is that it is small and has a cross-sectional design that makes it prone to selection bias. It is difficult to make a causal inference. We did not assess the level of physical activity in all participants, but patients with sub-acute pain were not included if they performed physical exercise more than 3 times a week, which may have contributed to significantly lower aerobic endurance in this group.

In conclusion the findings of the present study highlight the importance of fear-avoidance for physical activity in patients with sub-acute low back pain and question the concept of the deconditioning syndrome of patients with low back pain.

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