The relationship between activity and pain in patients 6 months after lumbar disc surgery: Do pain-related coping modes act as moderator variables?

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Abstract

Background: In LBP patients, the relationship between pain and physical activity remains unclear. Whereas a negative relationship between pain and self-reported physical activity was found, this relation disappeared in the case of overt behavioral data (e.g., accelerometer). Cognitive-behavioral models of the development of chronic pain suggest subgroups with signs of physical underuse and overuse.

Aims: To examine if patients with pain-related adaptive, endurance and fear-avoidance coping differ in pain, self-reported physical function and overt physical activity 6 months after disc surgery.

Methods: 24 patients completed questionnaires (Von Korff chronic pain grade (CPG), Kiel pain inventory (KPI), Funktionsfragebogen Hannover-Rücken FFbH-R) and underwent an 8-h accelerometer assessment in their daily life (physical activity level (PAL), number of constant postures (CP)). The KPI differed between adaptive coping (AC) (N = 9), fear avoidance coping (FAC) (N = 1) and endurance coping (EC) (N = 14).

Results: In the whole group, pain intensity was negative related to self-reported physical activity whereas PAL and CP displayed no correlation with pain. EC patients showed significantly higher pain scores and lower self-reported physical functioning compared to AC but the same level of PAL and furthermore, a significantly higher number of CPs in daily life. The visual inspection of the FAC patient revealed also high pain, low physical functioning and low overt physical activity.

Conclusions: The assessment of pain-related coping modes yielded an important differentiation between subgroups of LBP patients 6 months after surgery. Endurance copers displayed signs of overuse in their daily behavior in spite of pain than adaptive copers. The one fear avoidance coper tends to do less physical activity in the sense of underuse.

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Keywords: Low back pain; Physical activity; Coping; Fear-avoidance; Endurance

1. Introduction

Recurrence to normal activity after lumbar disc surgery is one of the most important long-term goals besides the reduction of pain. From a medical perspective, we expect that within six months after surgery, a patient is able to return to their normal activities in daily life as well as in their occupation. Nevertheless, several follow-up studies have shown that up to 40% of patients with primary lumbar disc operation show persistent or recurrent low back pain (Dvorak et al., 1988; Hasenbring et al., 1994; Valen and Rolfsen, 1998). It can be assumed that most of them would not have returned...
to their normal activities due to their pain. Thus, we would expect a negative correlation between the grade of pain intensity and physical activity in daily life.

During the past two decades, the relationship between pain and physical activity in chronic low back pain (CLBP) patients was widely investigated. In the early eighties, Fordyce and co-workers (Fordyce et al., 1981) found a negative relationship between ratings of pain intensity in CLBP patients and reported activity behavior. Patients who reported higher pain intensity also reported lower activities in daily living, such as lower sitting tolerance. Using self-report measures for the assessment of pain-related interference with daily activities, research has shown higher interference or higher disability in CLBP patients compared to healthy controls (Deyo and Diehl, 1983; Nielens and Plaghki, 2001). Low physical activity is one part of a multidimensional “disuse syndrome” with long-term inactivity, muscular atrophy, decreased cardiovascular endurance and decreased neuromuscular coordination (Mayer and Gatchel, 1988). Whereas the physiological components of muscle atrophy have been shown by magnetic resonance imaging (MRI) in CLBP patients compared to healthy controls (Gibbons et al., 1997) the role of the physical activity level (PAL) in daily life remains unclear. A few studies that assess physical activity not only by self-report measures but also by overt behavioral methods found no difference in actual physical activity between CLBP patients and healthy controls, neither in adults (Verbunt et al., 2001) nor in children (Wederkopp et al., 2003). They found also no correlation between self-ratings of pain intensity and the actual PAL in CLBP patients (Sanders, 1983; Linton, 1985; Vendrig and Lousberg, 1997; Verbunt et al., 2001; Wederkopp et al., 2003; Wittink et al., 2003). Wittink et al. (2003) discussed the possibility that a subgroup of CLBP patients will under-report or underestimate their actual ability to function physically.

In the meanwhile, several behavioral models assume that different strategies in coping with pain play a role in the process of the development of chronic back pain via changes in physical activity. The fear-avoidance model (Philips, 1987; Vlaeyen and Linton, 2000) suggests a subgroup of CLBP patients who are afraid of an increase of pain caused by an increase of physical activities. Even in situations with low activity-related pain, they show cognitions of catastrophizing (‘I’m afraid that something serious might happen’) and tend to avoid most of these activities. They reach a state of chronic inactivity with all signs of the disuse syndrome described above. Besides this, the avoidance-endurance model of chronic pain (Hasenbring, 1993, 2000) suggests a further subgroup of CLBP patients who try to ignore pain sensations by attention diversion and who tend to finish all activities in spite of severe pain (pain-related behavioral endurance). In their cognitions, they display pain-related thought suppression (‘It is important not to let myself go!’). It is assumed that these patients will display physical overexertion with long-lasting one-sided postures of strain that lead to a physical overload on the muscles, joints and discs with increasing pain as a result (Nachemson, 1987).

Based on these behavioral models of pain chronicity it can be suggested that patients with endurance coping (EC) will display more physical activity in daily living but also higher pain intensity compared to patients with low endurance coping. We further assume that patients with fear-avoidance coping (FAC) will display more pain but less daily activities. Patients with low EC as well as with low FAC are called adaptive copers (AC). We hypothesize in detail:

- Patients with pain six months after first lumbar disc surgery will display less self-report daily activities than pain-free patients will, whereas there will be no difference between these groups in overt behavioral activity.
- FAC as well as EC patients will display more pain intensity, less self-reported functional capacity and more fatigue compared to AC patients.
- EC patients will show more overt physical activity in daily life than AC whereas FAC will show less actual physical activity.

2. Method

2.1. Participants

A total of 50 patients were screened from the hospital archives by one of the authors. The inclusion criteria were a first lumbar disc surgery 5–9 months before and the ability to read and write German. The exclusion criteria were a new acute spinal origin of persistent or recurrent pain that demanded a second operation immediately, cancer, severe structural deformity, severe instability, severe osteoporosis, a fresh fracture, inflammatory disease of the spine and psychiatric disease. Because of these criteria, three patients were omitted. Seventeen patients were not available for the authors or did not agree with the participation. Of the 30 patients, six patients dropped out due to incomplete data (questionnaires or the technical measurement). Before the measurements began, the participants signed an informed consent form. The local University Ethics Committee approved the study.

2.2. Measures

2.2.1. Overt physical activity

A triaxial accelerometer (dimensions: $7 \times 2 \times 0.8$ cm; weight: 30 g), consisting of 3 uniaxial piezoresistive accelerometers, was used to record accelerations related
to changes in velocity, as well as the gravitational acceleration. The recorder was worn around the waist containing two sensors and one sensor was attached to the upper leg. Acceleration signals were amplified and filtered according to Bouten et al. (1996). The data are expressed in counts per minute. Data collection continued uninterrupted for 8 h of a weekday. Output was stored in a data memory card within the accelerometer and read by a computer one day after data collection. Postures are distinguished from each other by using the low-pass filtered (0.5 Hz) derivatives of each signal (Bussmann et al., 1998; Veltink et al., 1996). The data were classified into the following categories: locomotion, standing, sitting, and lying, forward standing, forward sitting. The accelerometer was well validated by videotapes of different static postures and dynamic activities. Busser et al. (1998) found agreements between video and accelerometer data of about 89–96% during working situations. In patients after failed back surgery, agreements between 83% and 88% have been found (Bussmann et al., 1998).

Using an elastic belt, the system and sensors can be worn on the skin, hiding it from public sight. Patients were instructed to wear it during a normal weekday for at least 8 h, except when bathing, showering or swimming. The reason and the exact time of removal were recorded. In this study, no patient removed the accelerometer due to bathing, swimming or showering because these activities did not occur during the assessment period. The physical activity level (PAL) was expressed as the total sum of counts registered during an 8 h period. Constant postures (CP) were expressed as the total sum of static positions (sitting, standing, forward sitting, forward standing).

2.2.2. Questionnaires

- **Pain intensity and pain graduation**: average pain intensity during the preceding week, average and maximal pain intensity during the preceding three months, each using an 11-point numerical self-rating scale (NRS) with the end points “0” (no pain) and “10” (very severe pain). The severity of pain was assessed with the chronic pain grade (CPG) (Von Korff et al., 1992; German version by Klasen et al., 2004), a simple questionnaire based on measures of pain intensity and pain-related disability. The CPG differs between Grade I (low disability, low pain intensity), Grade II (low disability, high pain intensity), Grade III (high disability-moderated limiting) and Grade IV (high disability-severely limiting). Cronbach’s $\alpha$ was 0.82 for the German version (Klasen et al., 2004).

- **Self-reported physical functioning**: The physical functioning scale (Funktionsfragebogen Hannover-Ruëcken FfBH-R) is a 12-item questionnaire assessing pain-related physical functioning in several daily activities (standing for half an hour, lifting a load). The sum score reflects the percentage of physical functioning. A higher score indicates an increased percentage of physical functioning. The FfBH-R has been demonstrated to be a valid and reliable measure (Cronbach’s $\alpha$ 0.87) of the functional status in back pain patients (Kohlmann and Raspe, 1996). Further, two 0–10 NRS scales assessing pain-related limitations of daily activities from the CPG, (“In the past three months, how much has back pain interfered with your daily activities?”; “In the past three months, how much has back pain changed your ability to work (including housework?)”). Two NRS scales measuring the belief of future pain-related limiting within daily life and occupation were taken from the Vermont disability prediction questionnaire (VDPQ) (Hazard et al., 1996) (“How much trouble do you think you will have sitting or standing long enough to do your job, six weeks from now?”; “How certain are you that you will be working in six months?”).

- **Fatigue**: the multidimensional fatigue inventory (MFI) is a well validated 20-item questionnaire assessing several aspects of fatigue and activity. Cronbach’s $\alpha$ was 0.84. (Smets et al., 1995). The MFI was well validated within several clinical samples (e.g., Schneider, 1998; Breslin et al., 1998). Higher scores indicate a higher degree of fatigue.

- **Pain-related thought suppression and endurance behavior**: the thought suppression scale (TSS) of the Kiel pain inventory (KPI) (Hasenbring, 1994) consists of four items (“Pull yourself together”), describes the appeal not to think about pain. The behavioral endurance scale (BES) of the KPI consists of 11 items that focus on coping efforts to finish all activities just started in spite of severe pain (e.g., “I keep all appointments even though I don’t feel well”). Patients indicated on a 7-point scale (0 “never”, 6 “always”) how often they have acted in such a way in the past 14 days when they experienced pain. Higher scores indicate a higher number of self-reported endurance cognitions and behavior. Cronbach’s $\alpha$ was 0.91 for BES and 0.78 for TSS (Hasenbring, 1994).

- **Pain-related anxiety and avoidance behavior**: the anxiety/depression scale (ADS) is a 9-item scale of the KPI assessing pain-related feelings of anxiety and depressive/dysphoric mood. Cronbach’s $\alpha$ was 0.91. The avoidance of physical activities scale (APAS) of the KPI consists of 10 items (e.g., “I just lie down and do nothing else”) describing finishing or avoiding physically demanding activities due to pain on a 7-point NRS. Cronbach’s $\alpha$ was 0.86. Higher scores indicate a higher degree of pain-related anxiety or avoidance behavior. The four KPI scales are well validated within cross sectional as well as prospective studies (Grebner et al., 1999; Hasenbring, 1994; Hasenbring et al., 1994; Schulz-Kindermann et al., 2002).
2.3. Procedure

Subjects were invited 5–9 months after a first lumbar disc surgery by one of the authors (RW) to participate in this study. During the initial telephone contact, participants were screened for inclusion criteria as described above. Firstly, the accelerometer was attached to the participant by an assistant 1 h after getting up in the morning, shortly after showering. On the following day, the participant came to the hospital for a short standardized neuroorthopaedic evaluation and to fill in the questionnaires.

For differential analyses pain-related coping behavior was evaluated as endurance coping (EC) if the scores of the KPI scales TSS and/or BES were above or equal the fixed cutoff score of 3. If these scale scores were below this cutoff score, participants were evaluated as fear avoidance copers (FAC) if the TSS/BES scores were below 3 and if the KPI-APAS score was above the median and if depression (BDI) was above the cutoff score of 9. Subjects were evaluated as adaptive copers (AC) if the TSS/BES and BDI scores were below the cutoff scores and if the APAS score was below the median. The theoretical background of this evaluation is the avoidance-endurance model of chronification of pain, which is described elsewhere (Hasenbring, 1993, 2000).

2.4. Statistical analysis

Results were expressed as means, standard deviations (SDs) and as medians. Bivariate correlations were performed by Pearson coefficient. Group differences regarding pain intensity, self-reported disability, fatigue, and objective accelerometer data were calculated by a multivariate analysis of variance (MANOVA). \( \chi^2 \) was used to analyse group differences with regard to gender. Homogeneity of covariances was ascertained by the Box-M test. Mann–Whitney \( U \) test was used to calculate the difference between the pain and no-pain groups regarding the single item self-reported interferences with daily activities and beliefs in future recovering (CPCG and VDPQ items). For a better interpretation of the differences between the pain-related coping groups, the individual scores of the dependent variables were transformed into \( T \)-scores. The analysis was performed using the Statistical Package for the Social Sciences SPSS 12.0.

3. Results

3.1. Study sample

Measurements of 24 (9 men, 15 women) subjects could be used for the analysis. Participants ranged in age from 24 to 60 years (mean = 43.5; SD = 9.4). 19 (79.2%) were married, 5 (20.8%) were single or divorced. 19 (79.2%) had a fulltime or part-time job. No patient was involved in disability claim.

Mean and median scores for all self-report data as well as for the accelerometer scores are presented in Table 1. Multivariate analysis of variance revealed no sex differences for these variables.

3.2. Bivariate correlations between pain intensity and self-reported and overt behavior

Table 2 presents bivariate correlations between the pain ratings and all other self-report and overt behavioral variables. Whereas self-reported physical functioning revealed a significant negative correlation with self-rated pain intensity, the overt behavioral parameters, assessed with the accelerometer did not show significant interrelations with pain. Most of the other self-report data displayed significant positive interrelations with pain: fatigue as well as several coping modes like thought suppression, behavioral endurance and pain-related anxiety/depression. Against our expectations, avoidance behavior did not show any significant correlations with the pain intensity ratings.

3.3. Differences between patients with ongoing pain and patients with no or low pain

Twelve patients (50%) had no or low scores in mean pain intensity over seven days ("0", "1" or "2" on the
11-point NRS). They constituted the group “No/low pain”. Three of them reported no pain during the past three months. Table 3 presents mean differences between the no/low pain group and 12 patients who suffered from moderate or severe pain (“3”–“10”) in several self-reported and overt behavioral data. Because the pain group was significantly older than the no/low pain patients were, age was further treated as a covariate. An analysis of covariance (MANCOVA) with the dependent variables pain intensity (three variables), physical functioning (FFbH-R) and two accelerometer data (physical activity level (PAL)) and the number of constant postures (CP) revealed a significant group difference for all three pain intensity ratings and also for the FFbH-R. With respect to the self reports, the pain group showed higher pain scores and a lower level of physical functioning. Nevertheless, both groups did not differ in the overt behavioral data, assessed with the accelerometer. The nonparametrical calculation of group differences regarding the four single items assessing the perceived interference with daily activities or work and the beliefs in future recovering showed significantly more limitations in the pain group compared to the patients with no or low pain. The differences were restricted to such items, which describe limitations of general activities. No group differences were seen for both work-related items.

Table 2
Bivariate correlations (Pearson) between three pain ratings and self-reported data as well as with accelerometer scores

<table>
<thead>
<tr>
<th></th>
<th>Self-reported pain intensity measures</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average pain/last week</td>
<td>Average pain/3 months</td>
<td>Maximal pain/3 months</td>
</tr>
<tr>
<td><strong>Physical functioning and fatigue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-reported physical functioning (FFbH-R)</td>
<td>$-0.61^{**}$</td>
<td>$-0.71^{**}$</td>
<td>$-0.49^*$</td>
</tr>
<tr>
<td>Fatigue (MFI)</td>
<td>$0.44^*$</td>
<td>$0.49^*$</td>
<td>$0.51^*$</td>
</tr>
<tr>
<td><strong>Pain-related coping</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thought suppression scale (KPI/TSS)</td>
<td>$0.30$</td>
<td>$0.42^*$</td>
<td>$0.54^{**}$</td>
</tr>
<tr>
<td>Behavioral endurance scale (KPI/BES)</td>
<td>$0.41^*$</td>
<td>$0.43^*$</td>
<td>$0.51^*$</td>
</tr>
<tr>
<td>Anxiety/depression (KPI/ADS)</td>
<td>$0.45^*$</td>
<td>$0.49^*$</td>
<td>$0.54^{**}$</td>
</tr>
<tr>
<td>Avoidance of physical activities (KPI/APAS)</td>
<td>$-0.06$</td>
<td>$-0.07$</td>
<td>$-0.19$</td>
</tr>
<tr>
<td><strong>Accelerometer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity level (PAL)</td>
<td>$0.28$</td>
<td>$0.28$</td>
<td>$0.22$</td>
</tr>
<tr>
<td>Number of constant postures (CP)</td>
<td>$0.20$</td>
<td>$0.16$</td>
<td>$0.07$</td>
</tr>
</tbody>
</table>

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

Table 3
Results of multivariate analysis of covariance (MANCOVA) for the comparison of patients with no/low pain and patients with moderate/severe pain 6 months after surgery in pain intensity, self-reported physical functioning and in objective accelerometer data (age was treated as a covariate). Group differences for the single item self-reported activities were calculated by nonparametric Mann-Whitney U tests, differences with respect to gender were calculated by Chi square.

<table>
<thead>
<tr>
<th></th>
<th>No/low pain $(N = 12)$</th>
<th>Pain $(N = 12)$</th>
<th>$F$ (df = 1)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>39.83 8.84</td>
<td>48.9 7.74</td>
<td>6.41</td>
<td>0.020</td>
</tr>
<tr>
<td>Gender (percent female)</td>
<td>57.1%</td>
<td>42.9%</td>
<td></td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Self-reported pain intensity (0–10)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average pain intensity 7 days</td>
<td>0.75 0.87</td>
<td>5.58 1.92</td>
<td>47.32</td>
<td>0.000</td>
</tr>
<tr>
<td>Average pain intensity 3 months</td>
<td>1.67 1.56</td>
<td>5.08 2.27</td>
<td>12.08</td>
<td>0.002</td>
</tr>
<tr>
<td>Maximum pain intensity 3 months</td>
<td>2.83 2.59</td>
<td>6.92 1.88</td>
<td>19.83</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Self-reported physical functioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFbH-R physical functioning (%)</td>
<td>85.76 20.29</td>
<td>59.03 27.74</td>
<td>4.88</td>
<td>0.038</td>
</tr>
<tr>
<td><strong>Self-reported daily activities (0–10)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPCG-interference with daily activities</td>
<td>0.91 1.62</td>
<td>3.58 3.02</td>
<td>Z: $-2.40$</td>
<td>0.020</td>
</tr>
<tr>
<td>CPCG-interference with work</td>
<td>1.16 1.89</td>
<td>3.66 3.86</td>
<td>Z: $-1.63$</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Belief in future recovering (0–10)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VDPQ-belief in future limiting of sitting/standing</td>
<td>0.75 1.48</td>
<td>3.75 3.36</td>
<td>Z: $-2.49$</td>
<td>0.017</td>
</tr>
<tr>
<td>VDPQ-belief in return to work</td>
<td>10.00 0.00</td>
<td>7.33 4.32</td>
<td>Z: $-1.88$</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Overt behavioral data: accelerometer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity level (PAL)</td>
<td>1.47 0.28</td>
<td>1.56 0.25</td>
<td>0.49</td>
<td>n.s.</td>
</tr>
<tr>
<td>Number of constant postures (CP)</td>
<td>1192.42 397.77</td>
<td>1280.75 528.84</td>
<td></td>
<td>0.12</td>
</tr>
</tbody>
</table>
3.4. Differences between pain-related coping groups

$N = 9$ participants fell into the category adaptive coping (AC), $N = 14$ were classified as subjects with endurance coping (EC). Only one patient showed marked fear avoidance coping (FAC). Therefore, the following statistical analyses of group differences were restricted to a comparison of AC and EC. The groups did not differ with regard to age and gender. A multivariate analysis of variance (MANOVA) for the dependant variables average pain intensity (3 months), overt physical activity and the number of constant postures yielded a significant overall effect ($F_{\text{Wilks-Lambda}(3,18)} = 5945, p = 0.005$). The EC patients revealed a significantly higher level of pain intensity compared to the AC patients, whereas there were no differences with respect to the overtly assessed activity level PAL. Further, EC displayed a significantly higher number of constant postures with static positions (sitting, standing, forward sitting and forward standing) during the 8 h assessment period than the AC. As the Box-M test had shown a significant heterogeneity of the covariances for the variables self-reported physical functioning (FFbH-R) and general fatigue (MFI), a non-parametrical analysis of group differences was conducted. The Mann-Whitney $U$ test revealed significant group differences for both self-reported variables: EC showed a higher level of fatigue ($p < .002$) and a lower level of physical functioning ($p < .002$) compared to AC (Table 4).

Fig. 1 shows the mean scale scores, converted to $T$ scores (mean = 50, SD = 10), for AC and EC. For a visual analysis, the $T$-scores of FAC also were shown. Both EC and FAC revealed high pain intensity, low self-report physical functioning and high fatigue. Group AC showed an opposite pattern with low pain intensity, high physical functioning and low fatigue. The visual analysis of FAC is especially interesting for the number of constant postures. Whereas EC yielded a significantly higher number of constant postures than AC, the visual analysis implicated an opposite pattern in FAC.

### Table 4

Results of a multivariate analysis of variance (MANOVA) for the comparison of the groups Adaptive Coping (AC) and Endurance Coping (EC) in average pain intensity and overt behavioral scores. Group differences for the FFbH-R and MFI were calculated by nonparametric Mann-Whitney $U$ tests, differences with regard to gender were calculated by Chi square. Scores are also reported for the one FAC (Fear Avoidance Coping), which is not included into the statistical analyses.

<table>
<thead>
<tr>
<th></th>
<th>AC ($N = 9$)</th>
<th>EC ($N = 14$)</th>
<th>FAC ($N = 1$)</th>
<th>AC/EC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>42.11 (11.64)</td>
<td>44.43 (7.97)</td>
<td>49</td>
<td>1.123</td>
</tr>
<tr>
<td>Gender (percent female)</td>
<td>55.6%</td>
<td>71.4%</td>
<td>Male</td>
<td>$\chi$ = 0.608</td>
</tr>
<tr>
<td><strong>Self-reported data</strong>&lt;br&gt;Average pain intensity 7 days</td>
<td>1.44 (1.67)</td>
<td>4.14 (3.08)</td>
<td>5</td>
<td>5.74</td>
</tr>
<tr>
<td>FFbH-R physical functioning</td>
<td>91.67 (11.41)</td>
<td>59.52 (28.46)</td>
<td>79.17</td>
<td>Z = -2.86</td>
</tr>
<tr>
<td>MFI-fatigue</td>
<td>5.44 (1.59)</td>
<td>12.00 (4.75)</td>
<td>4.25</td>
<td>Z = -3.23</td>
</tr>
<tr>
<td><strong>Overt behavioral data</strong>&lt;br&gt;Physical activity level (PAL)</td>
<td>1.44 (0.27)</td>
<td>1.58 (0.25)</td>
<td>1.26</td>
<td>1.74</td>
</tr>
<tr>
<td>Number of constant postures (CP)</td>
<td>951.56 (377.84)</td>
<td>1464.85 (378.58)</td>
<td>606.00</td>
<td>10.08</td>
</tr>
</tbody>
</table>

Fig. 1. Mean scale scores, converted to $T$ scores (mean = 50, SD = 10), for AC and EC. For a visual analysis, the $T$-scores of FAC are also shown.
4. Discussion

In the case of self-reported measures, this study has shown a significant negative correlation between several pain intensity ratings and physical activity. However, using overt behavioural data for measuring physical activities in daily life, these correlations were disappointing. So far, the results are in line with several previous studies (Sanders, 1983; Linton, 1985; Vendrig and Lousberg, 1997; Verbunt et al., 2001; Wedderkopp et al., 2003; Wittink et al., 2003). In a group of 15 CLBP patients, Linton (1985) found a negative relation between physical activity and pain intensity in global interview reports as well as in a diary, but this relationship disappeared as the measure became overt in a cycle test. Verbunt et al. (2001) reported a remarkable disabling in 13 CLBP patients, assessed with the Roland Disability Questionnaire, but they did not find a lower level of physical activity compared to 13 age- and gender-matched healthy controls. In this study, physical activity was assessed with a triaxial accelerometer, similar to the accelerometer used in our study. Further, the accelerometer data have been validated with the doubly labeled water technique, that is generally accepted as the gold standard for physical assessment in daily living (Bouten et al., 1996). Spenkelink et al. (2002) found no difference between 35 CLBP patients and 10 non-symptomatic controls with respect to general physical activity, assessed with the Dynaport accelerometer. However, CLBP patients in this study showed a lower activity level during the evening. The authors suggested that patients need all their capacity to perform the tasks imposed during the day and consequently have less capacity left for their leisure time, in general the evening. In sum, these findings support the one hand the operant view of chronic pain (Fordyce et al., 1981) that points to the fact that environmental contingencies will have an influence on the individual behavior so that verbal self-reports won’t correspond with overt behavior. In contrast, Linton (1985) draws the conclusion, that “chronic pain is a set of behaviors, all of which are equally valid and important. What people say is just as important as what they do”. Nevertheless, the finding that CLBP patients did not show less physical activity in daily living compared to patients with no or low pain, does not confirm the postulated presence of disuse in CLBP patients in general.

For the first time, to our knowledge, the present study investigated possible individual differences in overt physical activities with regard to different modes of pain-related coping. Based on the avoidance-endurance model of chronicity of pain (Hasenbring, 1993, 2000) we distinguished between a fear-avoidance, endurance and an adaptive coping mode. The results implicated that whereas endurance copers reported significantly more pain, more fatigue and less physical functioning compared to the adaptive copers, they did not show less physical activities in general in the accelerometer data. These data support the hypothesis, that there is a subgroup of CLBP patients who possibly underestimate their actual ability for physical activities, who instead realize a “normal” level of physical activities in spite of pain. Furthermore, the endurance copers revealed a higher number of constant static postures with a higher number of sitting or standing postures with or without forward bending during the 8 h observation period, compared to the adaptive copers. Such postures have been shown to elicit a high load on lumbar discs as well as on the lumbar muscles (Nachemson, 1987; Andersson et al., 1974), they lead to a decrease of lumbar disc volume (Malko et al., 1999) as well as to a decrease of nutrients of the discs (Adams and Hutton, 1983; Handa et al., 1997). A reduction in elasticity and an increase in the degeneration of the discs (Acaroglu et al., 1995; Umehara et al., 1996) may be supposed as some of the long-term consequences.

Only one patient has been seen with marked fear-avoidance scores. This patient showed a comparably low number of constant postures, however, nothing could be said about the relation of this coping mode and physical activity within this study.

Fear avoidance variables have been seen as high risk factors for the development of chronic back pain in several prospective longitudinal studies (Burton et al., 1995; Hasenbring et al., 1994; Hildebrandt et al., 1997; Klenerman et al., 1995; Vlaeyen et al., 1995; Hallner and Hasenbring, 2004). Using the KPI, also endurance coping strategies were positively related to the persistence or recurrence of low back pain (Hasenbring et al., 1994; Hallner and Hasenbring, 2004). These results indicated that psychological treatment procedures should be offered not to all CLBP patients but mainly to subgroups with enhanced maladaptive coping patterns. A first randomized controlled trial offering cognitive-behavioral interventions to sciatic pain patients supplementary to a conservative medical treatment, only when they show maladaptive coping patterns. This procedure led to a higher decrease of pain than a standardized behavioural approach, which was offered to all patients (Hasenbring et al., 1999).

In a theoretical review published recently, Vlaeyen and Morley (2004) pointed to the putative role of “stop-rules”, patients may use implicitly or explicitly, which guide them in persisting or terminating a given task. The authors suggested that in the case of negative mood, the “As-Many-As-Can (AMAC)” stop-rule would be used when the individual persists until satisfaction is reached about dealing with the task. In this case, the individual will be at risk for physical overuse, which is assumed as one way into increased disability. In contrast, when patients use the “feel-like-discontinuing
(FLDC)’ stopping rule, activities are terminated because the individual is not enjoying the task anymore. In this case, the FLDC stop rule will be lead to avoidance behaviour and, mediated by disuse, to increased disability. Based on these hypotheses, the development of a measure for the assessment of individual stop-rules that guide the termination or persistence of activities when experiencing pain, will be of special interest. One of the most important consequences of investigating special subgroups of CLBP patients will be a better matching of patients to different treatment strategies, as several authors claim for (Morley and Vlaeyen, 2005; Turk, 2005; Vlaeyen and Morley, 2005).

Some caution is needed in interpreting the results of the present study. The present research is merely a pilot study that for the first time has shown differential effects in actual physical activity with regard to different pain-related coping modes. Further, the 8 h observation period of overt physical activity represents a small part of the weekday, which is largely determined by fixed working and household tasks. Otherwise, this observation period is the only one, which is probably comparable over different days (Spenkelink et al., 2002). During the weekend as well as during the evening of a day, the intra-individual variability is very large due to different spontaneous activities (Gretebeck and Montoye, 1992; Spenkelink et al., 2002). In order to compare also patients with marked fear avoidance coping, a replication study with a larger number of patients is needed before we can draw valid conclusions regarding the relation between actual physical activities in daily life and pain.

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