Are fear-avoidance beliefs in low back pain patients a risk factor for low physical activity or vice versa? A cross-lagged panel analysis

Sind Angst-Vermeidungsüberzeugungen bei Kreuzschmerzpatienten ein Risikofaktor für geringe körperliche Aktivität oder vice versa? Eine Cross-lagged-panel-Analyse

Abstract

Objective: The assumption that low back pain (LBP) patients suffer from "disuse" as a consequence of high fear-avoidance beliefs is currently under debate. A secondary analysis served to investigate whether fear-avoidance beliefs are associated cross-sectionally and longitudinally with the physical activity level (PAL) in LBP patients.

Methods: A total of 787 individuals (57% acute and 43% chronic LBP) were followed up over a period of one year with measurements of fear-avoidance beliefs and physical activity level. Fear-avoidance beliefs concerning physical activity were measured by the physical-activity subscale of the FABQ (Fear-Avoidance Beliefs Questionnaire), the physical activity level was assessed in weighted metabolic equivalents (MET) hours/week with a German self-report questionnaire. Data were investigated by structural equation modelling in a cross-lagged panel design for the whole sample and separately for acute and chronic LBP.

Results: The acute and chronic sub sample increased their total physical activity level significantly after one year. The structural equation modelling results did not support the disuse-aspect inherent in the fear-avoidance belief model. Cross-lagged path coefficients were low (.04 and .05 respectively) and, therefore, did not allow to predict final physical activity by initial fear-avoidance beliefs or vice versa.

Discussion: Consequently, due to missing links between fear-avoidance beliefs and physical activity in a longitudinal design, the assumptions of the fear-avoidance belief model have to be questioned. These findings are in line with other investigations published recently. Most probably, "fear-avoidance belief" represents a cognitive scheme that does not limit activity per se, but only is directed to the avoidance of specific movements.

Keywords: fear-avoidance belief, physical activity, low back pain, structural equation modelling

Zusammenfassung

Zielsetzung: Die Annahme, dass Kreuzschmerzpatienten eine reduzierte körperliche Aktivität im Alltag zeigen („Disuse-Syndrom") wird derzeit diskutiert. Mit einer Sekundäranalyse wurde hier untersucht, ob Angst-Vermeidungsüberzeugungen quer- und längsschnittlich mit dem Aktivitätsniveau bei Kreuzschmerzpatienten assoziiert sind.

Methode: Es gehen in diese Untersuchung über ein Jahr Messungen der Angst-Vermeidungsüberzeugungen und der körperlichen Aktivitätslevel von insgesamt 787 Patienten (57% mit akuten und 43% mit chronischen Kreuzschmerzen) ein. Die Angst-Vermeidungsüberzeugungen bezüglich körperlicher Aktivität wurden mit einer Subskala des FABQ (Fear-Avoidance Beliefs Questionnaire), die körperliche Aktivität

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mit einem deutschen Selbstberichtsfragebogen (Freiburger Fragebogen zur körperlichen Aktivität) in metabolischen Einheiten (Energieumsatz) erhoben. Die Daten wurden mit Strukturgleichungsmodellen in einem Cross-Lagged-Panel-Design ausgewertet – sowohl für die Gesamtstichprobe als auch getrennt für akute und chronische Patienten.

Ergebnisse: Die akuten und auch chronischen Kreuzschmerzpatienten steigerten ihre körperliche Aktivität über ein Jahr. Die Ergebnisse der Strukturgleichungsmodelle konnten das „Disuse-Syndrom", wie es die sog. Fear-Avoidance-Modelle vorhersagen, nicht bestätigen. Die überkreuzten Pfadkoeffizienten waren niedrig (.04 und.05) und erlaubten daher nicht, körperliche Aktivität durch die anfänglichen Angst-Vermeidungsniveaus vorherzusagen oder umgekehrt.

Fazit: Da es insgesamt kaum Beziehungen zwischen dem Angst-Vermeidungsniveau und körperlicher Aktivität in einem Längsschnittdesign gab, müssen diesbezügliche Annahmen der Fear-Avoidance Modelle überdacht werden. Unsere Ergebnisse stehen im Einklang mit einigen anderen jüngst publizierten Ergebnissen. Wahrscheinlich repräsentieren Angst-Vermeidungsüberzeugungen ein kognitives Schema, das nicht die Aktivität bei Kreuzschmerzpatienten generell verringert, sondern nur bestimmte Bewegungen vermeiden lässt.

Schlüsselwörter: Angst-Vermeidungsüberzeugungen, körperliche Aktivität, Kreuzschmerz, Strukturgleichungsmodell

Introduction

The "fear-avoidance model" explains why a minority of low back pain sufferers develop a chronic pain problem [1], [2], [3]. Long term consequences of catastrophic misinterpretations of pain initiate a vicious circle of pain-related fear, associated safety seeking behaviours, avoidance of physical activity and, finally, the emergence of a "disuse syndrome" as a consequence of long lasting avoidance behaviour [4]. The "disuse syndrome" refers to the physiological and psychological consequences of long-term inactivity whereas the term "disuse" can be described as a behavioural component leading to physical inactivity [5]. "Physical deconditioning" is thought to represent one aspect of disuse, namely a decreased level of physical fitness such as a reduced level of aerobic fitness, as well as a loss of muscular strength and endurance [3], [6]. Following this model, fear-avoidance beliefs (FABs) should predict (reduced) physical activity in the course of low back pain.

Hasenbring et al. [7], [8] put forward another explanation for the process of chronicity: the avoidance-endurance model. These authors found a subgroup of chronic LBP patients who, due to personal characteristics, overstrain their muscles by maintaining or even increasing the level of physical activity they used to show prior to the occurrence of pain. In comparison with the fear-avoidance-coping strategy these patients could display more physical activity in daily living [8]. In the long run this way of coping will result in low levels of activity, too [5].

"Disuse" and "deconditioning" as components of the "fear-avoidance model" are not unambiguously confirmed by recent studies [3]. In the first place, it is unclear whether a low back pain (LBP) patient's physical fitness level really decreases after pain-onset [9], [10]. Additionally, differences between LBP patients and healthy controls in the level of physical activity measured by self report or activity monitoring have not been unambiguously confirmed [11], [4]. But on the other hand Spenkelink et al. [12] and Nielens and Plaghki [13] detected lower activity patterns in patients with chronic LBP.

Decreased activity patterns may as well be explained by changes in life style due to absenteeism or loss of the work place often associated with ongoing pain [5]. Other authors assume that possible changes in physical activity cannot be explained by changes in intensity, but by changes in the quality of the activity, e.g. disordered motor coordination [3]. Pincus et al. [14] conclude in a review that there may be other pathways to avoidance behaviour besides feelings of fear.

In summary, there is growing evidence that FABs do not automatically lead to decreased levels of physical activity in LBP patients, although few studies exist that use a longitudinal design. Such a design is essential to evaluate mutual causal dependencies of FABs and PAL [5].

Cook et al. [15] applied "structural equation modelling" in a cross-sectional analysis of a heterogeneous sample of chronic pain patients and were able to confirm relationships suggested by the fear-avoidance model. In contrast to the Cook et al. study, the present study only includes patients with a diagnosis of LBP and holds the potential to suggest causal relationships due to the longitudinal design. Taking into consideration that the association between FABs and physical activity may be different in acute and chronic LBP-patients [16] our assumptions of the study are:

1. High fear-avoidance beliefs result in low levels of physical activity at a one year follow-up.

2. Low levels of physical activity result in (due to a vicious circle) more pain and, consequently, in high fear-avoidance beliefs at a one year follow-up.
3. There are differences in the associations between fear-avoidance beliefs and physical activity in acute and chronic low back pain sufferers.

Methodology

Design

This post hoc analysis is based on data that emanate from a three-armed randomized controlled intervention study in primary care. The study design and the interventions have been described in detail previously [17], [18], [19]. The present cohort sample comprises all patients with complete measurement enrolled in that trial. The primary objective of the RCT (randomized controlled trial) was to assess the impact of guideline-based treatment and motivational counseling on functional capacity in patients with LBP. The intervention consisted of intensive seminars for general practitioners on an evidence-based LBP guideline (in both intervention arms) and of a training of practice nurses in motivational counseling to promote patients' physical activity (in one intervention arm). In the control group, the general practitioners received only the guideline via mail. The study was conducted in two centers in Germany (Marburg, Göttingen) in the period from 2003 to 2004.

We contacted 818 general practices surrounding both study centres; addresses were obtained from local health authorities. 118 practices agreed to participate. Ethical approval was obtained from both study sites.

The statistical analysis did not reveal differential effects of the interventions neither for physical activity nor fear-avoidance beliefs, thus enabling inclusion of the whole sample in the present analysis [18], [19].

Inclusion criteria

During the recruitment period, practice nurses asked consecutive patients with LBP to participate in the study. All patients meeting the inclusion criteria during the recruitment period were registered. Inclusion criteria were LBP as presenting symptom on the day of inclusion, age above 19, ability to read and to understand German, and written consent. Exclusion criteria were pregnancy and isolated thoracal or cervical pain.

Data collection and outcome measures

At the index visit, patients were asked to fill out two sets of questionnaires, one while waiting and another one at home (socio-demographic and disease-related data). One baseline telephone interview (within 4 weeks) and two follow-up interviews (after 6 and 12 months) were performed by specially trained study nurses.

General practitioners evaluated each patient regarding warning signs for complicated LBP ("red flags").

The following measures from baseline and the second follow-up interview are included in the present analysis: Physical activity was assessed by the *Freiburger Questionnaire on Physical Activity* (FQPA). The questionnaire [20] uses 12 items to detect the amount, frequency and intensity of habitual physical activity during the preceding week (e.g. "Did you go by feet to work or shopping last week?" [Answer yes/no]. "If yes, how long did you go?" [Answer in minutes per week]. "How would you describe your intensity?" [Answer in a 3-stage response format: unhurried/normal pace/speedy]). The FQPA has satisfactory measurement properties and allows a calculation of weighted metabolic equivalent (MET) hours/week. One MET represents the amount of oxygen used by an average seated person and increases with the intensity of exercise.

The coding for the MET intensity of the different activity types is based on the compendium of physical activities from Ainsworth et al. [21]. The total MET score for each participant can be calculated by multiplying the duration of an activity by the energy expenditure listed for this activity. Activities are listed in the compendium as multiples of the resting MET level and range from 0.9 (sleeping) to 18 METs (running at 10.9 mph). The scores can be summarized in METs/week or in kcal/week for daily activities (low to moderate intensities), leisure time physical activity, sports activity and an overall estimate of total physical activity.

Frey et al. [20] report retest-reliability-scores between $r=.35$ and $r=.91$. The questionnaire is more differentiated than the International Physical Activity Questionnaire (IPAQ) [22] and accounts for the different contexts of physical activity which is highly recommended especially in patients with chronic LBP [5].

For the measurement of fear-avoidance beliefs we utilized the German version of the *Fear-Avoidance Beliefs Questionnaire* (FABQ [23]) by Pfingsten et al. [24]. This questionnaire assesses the cognitive aspect of pain-related fear-avoidance on 7-point Likert-scales focusing on patients' beliefs about how physical activity and work affect LBP. The German FABQ version shows a different factor structure from the original English version. The factor "physical activity" remained the same as in the English version, the second factor of the original version split into two: one related to, "work as cause of pain" and the other to "patients' assumptions of their probable return to work" [25]. The subscales showed modest to good internal consistencies. In the present context, the subscale "physical activity" (FABQphys; range from 0–30) was used to determine the relationship between beliefs and reported physical activity (e.g." Physical activity might harm my back", "My pain was caused by physical activity."). Pfingsten et al. [25] found a Cronbach's α=.69, whereas we calculated a Cronbach's α=.73 in a sample of primary care patients [26].

A procedure suggested by von Korff [27] served to classify the *natural history of LBP*. Patients were assigned to an

Baseline   **12-months Follow-up**
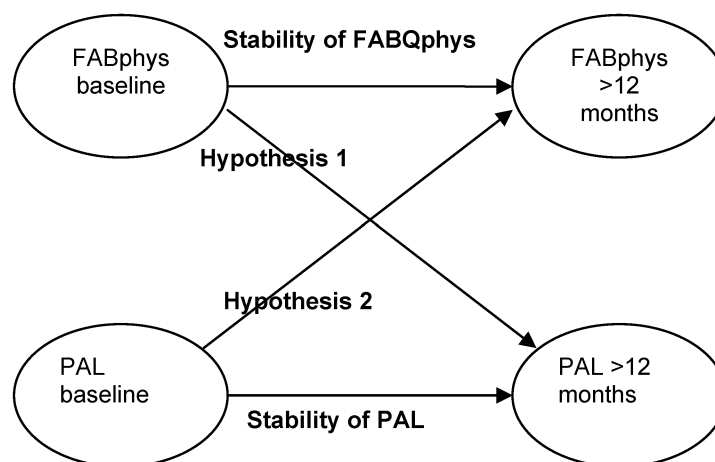
FABphys: fear-avoidance beliefs concerning physical activity (FABQ, scale 1)
PAL: physical activity level in MET-hours/week (Freiburger Questionnaire on Physical Activity)

Figure 1: Reciprocal causation model

acute status if they had experienced one single episode of LBP of less than 90 days duration within the last 12 months. Patients assigned to a chronic status indicated multiple episodes of LBP of less than 90 days duration or more than 90 consecutive days of LBP within the last 12 months.

Descriptive data are shown for functional capacity (Hannover Functional Ability Questionnaire for Measuring Back Pain-Related Functional Limitations; HFAQ [28]), pain-intensity, depression (CES-D, German version [29]) and sociodemographic characteristics.

Statistical analyses

Preliminary and univariate analyses

Since the distribution of the MET hours/week was highly skewed, we report mean and median values when appropriate. We also performed an outlier correction for MET hours/week by "winsorizing" the distribution (values of the 98th percentile and above were set to this value).

In a first step, descriptive data of the variables incorporated into the structural equation model (SEM) as well as bivariate correlations have been computed for the total sample and separately for acute and chronic patients utilizing the statistical package SPSS 12.0.

Structural equation modeling

The subsequent structural equation model relied on the AMOS 6.0 computer program [30]. A two-wave cross-lagged panel analysis was conducted to examine the associations between FABs und the physical activity level. Crossed lagged panel designs can be analysed by struc-

tural equation modelling. Within this approach different associations can be analysed (Figure 1). It is possible to explore the data cross-sectional and the stability of the variables over time (stability coefficients). Moreover normal causal effects can be calculated (hypothesis 1) as well as reversed effects (hypothesis 2) which can be done in a reciprocal causation model (combining regular and reverse causation).

Model identification

Physical activity was operationalized as a manifest variable (MET-hours/week) in the model. It was not possible and not expedient to conceptualize physical activity as a latent variable. With the FQPA (Freiburger Questionnaire on Physical Activity) different activity types can be summarized to a total amount of physical activity in MET-hours/week which is a valid self-assessment of physical activity. Because of the inevitable heterogeneity of this variable the specification of a latent variable was not reasonable. This was emphasized by exploratory factor analyses of the questionnaire. Due to characteristics of AMOS software we had to generate an artificial latent variable, by adding an error term to the manifest variable and fixing the error variance to 0 and the loading value to 1 in order to identify the fully cross-lagged model.

The extent of FABs was conceptualized as a latent variable represented by two item parcels (groups of items). Item parcelling has the advantage of higher reliability compared with item-level data and models based on parcelled data are more parsimonious [31]. We created the identical parcels for both time-points on the basis of exploratory conducted factor and reliability analyses.

Variations in item-parcelling had no effect on the associations between FABs and physical activity.

Following a recommendation of Hu et al. [32], we applied a maximum-likelihood-procedure (ML) because of its robust performance in a variety of situations. All analyses were based on the covariance matrix.

Assessment of model fit

Fit indices indicate the extent to which the covariances among the variables are accounted for by the hypothesized model. It is recommended to include absolute and incremental fit indices. Absolute fit indices assess how well an a priori model reproduces the sample data, while incremental fit indices measure the proportionate improvement in fit by comparing a target model with a more restricted baseline model. The following criteria were used (see [33], [34], [35], [36]):

We report chi-square statistic test (overall fit of the model) although this index is sensitive to sample size and often inflates Type 1 error. Non-significant or small chi-square values indicate that the model fits the data well. However, in large samples even small and substantively unimportant differences between the estimated model and the "true" underlying model will result in rejection of the model that is tested [37], [38]. Therefore, other indices are more appropriate and recommended for larger samples.

The "Root-mean-square error of approximation" (RMSEA [39]) is a fit measure based on population error of approximation. It quantifies the divergence between the data and a proposed model per degree of freedom. Values of .05 or less indicate a close fit in large samples.

The "Comparative fit index" (CFI [37]) is an incremental fit-index that produces a statistic in the range between 0 and 1. It represents the proportionate improvement in model fit by comparing the fitted model with an independence model. Indices of more than .90 are considered as good and ideally they are greater than .95.

The "Standardized root mean squared residuals" (SRMR) is a global fit index and refers to the fitted residuals. Values should ideally be close to .08 [36].

Results

Prior to the data analysis, selection bias had to be considered. While the overall drop out rate at the one year follow up was only 12%, 43% provided missing data in any one of the included variables at any one time. We decided to use the 57% of the original sample with complete panel data (N=787).

Mann-Whitney-U-tests for MET hours/week showed significant differences at baseline (*T1: Mann-Whitney Z*=−5.27, *p*<.01) and at the 1-year-follow up (*T2: Mann-Whitney Z*=−2.61, *p*<.01) between those who were included (*T1 M:* 37.4, *SD:* 31.9; *T2 M:* 46.7, *SD:* 37.8; *p*<.01) and those who were excluded from the present sample (*T1 M:* 31.5, *SD:* 33.5; *T2 M:* 41.5, *SD:* 34.9).

Changes in MET units over time were the same in both groups.

The sample of this secondary analysis was significant younger than that of the excluded patients (*M:* 48 years, *SD:* 12.9 versus *M:* 52 years, *SD:* 14.8; *t*=4.40, *df*=780.2, *p*<.01).

No differences were found for the initial values of fear-avoidance beliefs and gender.

Preliminary analyses

Sociodemographic and baseline characteristics

Of the whole sample, 57% are female with a mean age of 48 years. The chronic sub-sample is a little older (rounded mean age 50 versus 45 years) and comprises more female LBP sufferers (64% versus 50%). The level of education and the employment status is lower in the chronic sub-sample in comparison to the acute LBP patients. The amount of patients who applied for a pension in the chronic group of patients (13%) exceeds threefold the proportion in the group of acute patients (4%). Table 1 presents in detail selected demographic characteristics for the sample included here.

At baseline, the LBP patients already reported a relatively high amount of physical activity in the questionnaires. The MET hours/ week indicated a higher activity in the chronic LBP patients (*Mean*=41.1, *Median*=31.9, *SD*=34.3) compared to the acute sub-sample (*Mean*=34.7, *Median*=27.0, *SD*=29.7). Both groups increased their total physical activity level significantly after one year (*Mean*=45.3, *Median*=37.9, *SD*=34.1 and *Mean*=48.6, *Median*=36.2, *SD*=42.3, respectively). It is striking that the basic activity decreased in both groups (significant only in the chronic sub-sample) whereas the leisure time physical activity and sports activity increased over one year.

The FABQphys-scores were higher in the chronic sub-sample and decreased less to the 12-month follow-up assessment. Functional capacity (HFAQ) was higher at baseline and increased significant only in the acute sub-group.

Table 2 shows the selected descriptive characteristics and significant periodic changes for both sub-samples.

Bivariate correlations between physical activity and fear-avoidance beliefs

We calculated the bivariate correlations between the physical activity level (PAL)-scores and the FABQphys-scores from both time points. Because the total physical activity scores are highly skewed we report the Spearman's rank-correlations.

Overall, the correlations (displayed in Table 3) are unexpectedly low.

Table 1: Selected baseline characteristics

	Classification of pain at baseline	
	Acute **(<=90 days of pain per year)** **N=449**	**Chronic** **(>90 days of pain per year)** **N=338**
Age (Mean, SD)	45.4 (12.3)	50.4 (13.2)
Gender (N, %)		
Men	225 (49.9)	121 (35.8)
Women	224 (50.1)	217 (64.2)
Marital status (N, %)		
Single	81 (18.2)	42 (12.5)
Married	317 (71.4)	232 (69.0)
Widowed	13 (2.9)	19 (5.7)
Divorced	33 (7.4)	43 (12.8)
Living with partner (N, %)		
(Yes)	360 (82.8)	261 (79.6)
Level and years of education (N, %)		
13/12 years	141 (31.8)	76 (22.6)
10 years	160 (35.9	103 (30.7)
9 years	137 (30.8)	150 (44.6)
other graduation	5 (1.1)	7 (2.1)
No qualification	2 (0.4)	0 (0.0)
Employment status (N, %)		
Working full or part-time	337 (75.8)	202 (59.9)
Housewife	37 (8.3)	32 (9.5)
Retired	51 (11.5)	81 (24.0)
Unemployed	14 (3.1)	15 (4.5)
Other	6 (1.3)	7 (2.1)
Applied for a pension (N, %)	16 (3.7)	42 (13.1)
BMI (Mean, SD)	26.5 (4.77)	26.6 (4.6)
Job satisfaction (NRS 0–10) (Mean, SD)[a]	6.3 (2.3)	5.9 (2.5)
Depression (CES-D) (Mean, SD)	13.9 (9.0)	15.5 (9.0)

[a] only employed patients (N=342/209)
BMI: Body Mass Index [(weight in kg)/(height^2 in m^2)]
NRS: Numerical Rating Scale
CES-D: Center for Epidemiologic Studies Depression Scale (German version)

Structural equation modeling results

Fear-avoidance beliefs concerning physical activity were implemented as a latent variable in the model with two parcels from the FABQphys-scale. Internal consistencies of the parcels were α=.73/.68 at baseline and α=.78/.65 at the 12 month-measurement point.
We first tested the fit of the model with the cross-lagged coefficients of physical activity (PAL) and fear-avoidance beliefs (FABphys) for the whole sample according to our hypotheses 1 and 2.
The stability coefficients for PAL and FAB phys were .42 and .66, respectively. The cross-lagged correlations were very low with .05 for the path [FABphys Time 1] → [PAL 12 months] and .04 for the path [PAL time 1] → [FABphys 12 months].

Figure 2 presents the result of the tested cross-lagged-panel design within a 12 month time lag.
Overall, the model accounts for approximately 17% of the variance in long-term physical activity and for 43% of the fear-avoidance beliefs over one year.
The fit of the model was good with the following fit indices: χ^2 (5)=25.96, p<.001; CFI=.974, RMSEA=.0209; SRMR= .021.
According to our hypothesis 3 we performed two separately analyses, one for the acute and one for the chronic LBP-patients. The results were similar to the SEM-result for the whole sample with slightly different fit indices. The cross-lagged correlations for the acute subgroup were: [FABphys time 1] → [PAL 12 months] = .02, [PAL time 1] → [FABphys 12 months] = .03; and for the chronic subgroup: [FABphys time 1] → [PAL 12 months] = .08, [PAL time 1] → [FABphys 12 months] = .03.

Table 2: Selected descriptive characteristics at baseline and after one year

Mean (SD)	Acute LBP at baseline (pain <=90 days/year) N=449		Chronic LBP at baseline (pain >90 days/year) N=338	
	Baseline	>12 months	Baseline	>12 months
Total Physical Activity Level (MET-hours/week)	34.7 (29.7)	45.3 (34.1) [a] **	41.1 (34.3)	48.6 (42.3) [a] **
Median	27.0	37.9	31.9	36.2
Daily activities	16.8 (17.5)	16.2 (14.9)	20.7 (22.2)	16.9 (18.0) [a] **
Sportive activities	7.8 (12.4)	13.9 (18.5) [a] **	8.9 (13.9)	15.5 (20.4) [a] **
Leisure time activities	9.6 (11.4)	14.1 (16.5) [a] **	10.0 (11.1)	13.5 (16.8) [a] **
FABphys (physical activity)	17.0 (6.7)	15.2 (7.6) [b]**	18.4 (6.4)	17.8 (6.9)
Functional capacity (HFAQ)	69.6 (23.2)	81.5 (20.7) [b] **	64.7 (20.2)	65.3 (23.0)
Pain-intensity (NRS 0-10)	4.9 (1.7)	5.1 (1.4)	5.6 (1.6)	6.0 (1.5)

MET-hours/week: weighted metabolic equivalents in hours/week (energy expenditure)
FABphys: fear-avoidance beliefs concerning physical activity (FABQ, scale 1)
HFAQ: Hannover Functional Ability Questionnaire
[a] ** Wilcoxon-matched-pair-test: significant periodic change with p<.01
[b] ** t-test: significant periodic change with p<.01

Table 3: Correlations (Spearman-Rho) between fear-avoidance beliefs and physical activity at T1 (baseline) and T2 (1 year later)

	FABphys T1	FABphys T2	PAL T1
Whole sample (N=787)			
FABphys T1			
FABphys T2	.432**		
PAL T1	−.088*	−.010	
PAL T2	−.019	−.099**	.416**
Acute LBP patients (n=449)			
FABphys T1			
FABphys T2	.412**		
PAL T1	−0.93*	−.011	
PAL T2	−0.46	−.098	.428**
Chronic LBP patients (n=338)			
FABphys T1			
FABphys T2	.432**		
PAL T1	−.095	−.040	
PAL T2	.013	−.098	.411**

FABphys: fear-avoidance beliefs concerning physical activity (FABQ, scale 1)
PAL: Physical Activity Level (weighted metabolic equivalents in hours/week)
* significant p<.05
** significant p<.01
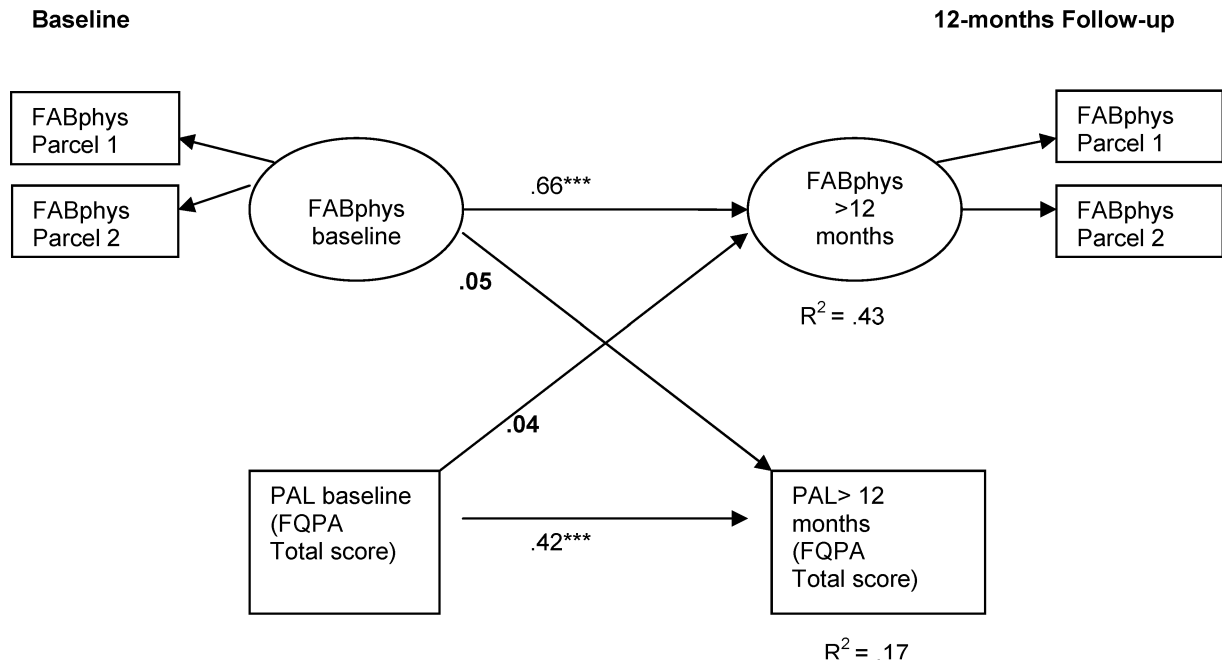
***p<0.001
FABphys: fear-avoidance beliefs concerning physical activity (FABQ, scale 1)
PAL: physical activity level in MET-hours/week (Freiburger Questionnaire on Physical Activity)
FQPA: Freiburger Questionnaire on Physical Activity

Figure 2: Structural equation model with a reciprocal causation design for the whole sample (N=787)

Table 4: Fit indices of tested models

Model tested	df	X^2	p	CFI	RMSEA	SRMR	R^2 PAL >12 months	R^2 FABphys >12 months
Whole sample (N=787)	5	25.96	<.001	.974	.0209	.021	.17	.43
Acute LBP patients (n=449)	5	13.63	=.018	.980	.062	.0197	.18	.38
Chronic LBP Patients (n=338)	5	12.27	=.031	.978	.066	.0252	.17	.49

X^2: Chi-Square goodness of fit test
CFI: Comparative fit index
SRMR: Standardized root mean squared residuals
RMSEA: Root mean square error of approximation
PAL: Physical Activity Level (weighted metabolic equivalents in hours/week)
FABphys: Fear-avoidance beliefs concerning physical activity (FABQ, scale 1)

Table 4 details the various fit indices for the three models tested.

Because of these unexpected findings we checked for correlation between the different types of physical activity (e.g. going upstairs, gardening, walking, and cycling) and the FABphys-score at baseline. The Spearman's rank-correlations turned out to be low ranging from .004 to .099.

Discussion

The results of the structural equation analysis did not support the assumptions. There was a good fit of the model that conceptualises physical activity as a manifest variable and FAB as a latent variable represented by two parcels of the FABQ- subscale "physical activity". Contrary to our expectations, the cross-lagged path coefficients were very low and neither allowed to predict physical activity at follow-up by initial FABs nor FABs at follow-up by initial activity. A separate analysis for acute and chronic states yielded the same results.

Inspection of the course of physical activity over a period of one year showed an increase both in the acute and in the chronic group as far as sportive and leisure time activities were concerned. The total physical activity score indicated a higher activity in the chronic LBP patients at baseline compared to the acute sub-sample. Activities of daily life, however, remained largely unchanged, even diminished in the chronic group. With respect to FABs, at the final assessment patients in both groups were less prone to attribute their present condition to the burden of physical activity. The belief that pain was due to past physical activity did change only in the acute sub group. Results reported in the literature appear inconclusive, but tend to support our findings. Elfving et al. [40] found an association between fear-avoidance beliefs and self-reported physical activity in a cross-sectional study. Physical activity was rated on a six-level scale for summer and winter activities, which seems less differentiated in comparison to the FQPA and to the computation of MET units. Elfving and colleagues dichotomized the physical activity score and analysed the associations by logistic regressions. Moreover, what the authors measured may have been closer to the construct of disability. In fact, the effect of pain-related fear on disability was frequently reported in the past (e.g. [41], [42], [16]). The results of other authors, however, corroborate our findings. In addition to those studies reported in the introduction section, Verbunt et al. [4] also did not detect an association between fear-avoidance beliefs and aerobic-fitness (VO_2max) in patients with subacute non-specific LBP. Although Smeets et al. [43] found differences in aerobic fitness levels between CLBP patients and healthy controls, fear-avoidance beliefs were not associated with lower aerobic fitness. Leeuw et al. [3], in summarizing the empirical evidence, concluded that neither lower physical activity levels nor the physical consequences of long-term avoidance behaviour in CLBP patients have been confirmed to date.

In the present study, a decrease of basic activity was only found in the chronic sample, whereas both groups increased their sportive and leisure time activities. Comparable with our findings, Bousema et al. [9] did not see a change in physical activity in a sample of sub-acute LBP patients over one year. Accelerometer measurements as well as subjective reports did not allow the assumption of a general decline of physical activity; only a subgroup of individuals appeared to be affected. The authors concluded that CLBP patients in general seem to be able to cope with their pain in such a way that they maintain their daily activities.

With regard to the unexpected result that the chronic subgroup has a higher amount of total physical activity at baseline and follow-up we still have to keep in mind the possibility that a subgroup of patients could cope with their pain using endurance strategies and overload their muscles [8].

Our findings rather support the assumption that repeated measurements contributes to an increase of physical activity with the exception of activities of daily living in the chronic sample. One explanation might be that patients in the process of chronicity tend to avoid certain types of activities that appear especially harmful. Indeed, there is growing evidence for the assumption that fear of movement is not a phobic state generalized to reduced activity and deconditioning, but more likely a dysfunctional cognitive scheme for specific movements only. Kronshage [44] studied anxiety regarding certain movements with the startle paradigm. She and her colleagues hold the opinion that the FABQ [23] is indicative rather of cognitive components of activity related fear than of behaviour itself. Avoidance behaviour in terms of specific activities and not in terms of the total amount of physical activity probably reflects individual beliefs and attitudes concerning back stressing movements [45].This could also be an explanation for our findings: Patients only avoid movements which they assume to be dangerous, but do not reduce their general level of activity. This argument will be strengthened by findings from Vlaeyen et al. [46] who could show that individually tailored exposure in vivo treatment was superior to graded activity treatment in decreasing levels of fear of movement/ (re)-injury.

The explorative findings (low correlations of energy expenditure and different types of activity and FABs) lead to the hypothesis that increased fear-avoidance beliefs are not associated with the quantity but rather with the *quality of unique movements*.

Limitations

One limitation of the study is reliance on self-report instruments. Bias from failure of memory or social desirability cannot be excluded. Objective measurements like triaxial accelerometers will have to be included in future studies (see new recommendations from Verbunt et al. [47]). But even with the use of technological equipment, the control of performance bias remains difficult. It is well known that measurement itself produces higher activity scores [48]. We can also not exclude that repeated measurements contributed to a self-reported increase in physical activity.

On the other hand, the "Freiburger Questionnaire on Physical Activity" (FQPA) is a well-documented, validated questionnaire with allows a differentiated measurement of the modality, the intensity, and the duration of the activity. Moreover, apart from complex observation tools and physical examinations self-reports appear to be an effective way to determine the kind of activity an individual performs. They may be supplemented by the assessment of specific signs for deconditioning like neuromuscular changes or fibre changes of deep lumbar muscles [6]. As Verbunt et al. [4] underscored, several physical domains can be affected by disuse, not only activity in daily life. Nevertheless, from a methodological perspective the conclusion seems to be justified that our findings further support the assumption that there is no causal pathway neither from FABs to PAL nor from PAL to FABs. Another limitation is a potential selection bias. In fact, we have pointed out in prior analyses [19] that an increased

motivation for physical activity might have influenced the decision to participate. Moreover, in the present study individuals with incomplete data sets had to be excluded for methodological reasons. A statistical analysis showed that excluded individuals were older and less physically active both at the beginning and at the end of the study. This may explain why in comparison with a survey on the general German population [49] the level of physical activity in the present sample was unexpectedly high. Consequently, the assumption seems to be justified that the excluded patients might have been more disabled and less motivated to take any additional effort in addition to participating in the treatment options. In fact, the phenomenon that more disabled patients are less prone to collaborate meticulously in scientific studies has been observed before [50], [51]. Based on these findings, the generalization of the present results might be restricted to the sample of younger and more active individuals among patients with low back pain.

We did not stratify for gender. Indeed, there are findings that aerobic fitness levels are often less affected in female than in male pain patients [10], [13]. However, we could not find physical activity to be influenced by gender in prior analyses [26], and, therefore, abstained from gender analyses.

Conclusions

In the present study we did not find sufficient evidence to maintain the assumption of a general lack of physical activity in LBP patients and, therefore, of a need to have them "reconditioned". Although we cannot rule out selection bias in our study, we will have to think about other reasons that explain the positive outcome of exercise therapies [52] apart from solely an increase of physical fitness. Possibly, the change of cognitions like self-efficacy or perceived advantages of activity play a more important role in the adoption and maintenance of physical activity than fear-avoidance beliefs themselves. Consequently, the psychology of motivation in LBP patients does not appear to be so different from healthy individuals. George et al. [53] demonstrated that a fear-avoidance based physical therapy only showed beneficial effects in patients who scored high on a FAB-scale at the beginning (see also [54]). Smeets et al. [43] argued that we have to widen our perspective and have to admit the interplay between many different factors in the framework of a bio-psycho-social model that will have to be specified in future studies (e.g. Beta-Endorphin levels or other mediators, see [55]).

Future research will have to address the identification of specific activities avoided by the patients. This includes the elaboration of more specific assessment instruments with respect to both subjective self-report and objective measurements of (quantity and quality of) movements and activities. New studies should explore if increased fear-avoidance beliefs are associated with changes in movement *quality*. Moreover, the underlying mechanisms of the beneficial effects of functional restoration and reconditioning will have to be studied in more detail. The incorporation of fear-avoidance beliefs may only be an option for those individuals with very high scores on respective scales.

Notes

Conflicts of interest

None declared.

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