Original Article

Correlates of Self-reported Disability in Patients with Low Back Pain: The Role of Fear-avoidance Beliefs

Congcong Cai,[1] *MS, BS*, Yong-Hao Pua,[1] *BS*, Kian Chong Lim,[1] *BS*

Abstract

Introduction: The purpose of the study was to examine the determinants of self-reported disability – MODQ (Modified Oswestry Low Back Pain Disability Questionnaire) in patients with low back pain (LBP); and to examine the level of FABQ (Fear-Avoidance Belief Questionnaires) scores in an ambulatory clinical population referred to physiotherapy management. We believe that identifying potentially modifiable determinants of disability in patients with LBP provides an opportunity to broaden the strategies to reduce its socioeconomic burden. Materials and Methods: A retrospective study was designed to be conducted in the physiotherapy department of a local hospital. The data were taken from standard examination of patients [n = 162, female 15.4%, male 84.6%, age_{mean} = 30.6 years [standard deviation (SD), 11.4; range, 17 to 68)] presenting to the department with acute or chronic LBP. The data included physical examination of back, self-reported disability by MODQ, fear-avoidance beliefs by FABQ, pain intensity and demographic information. Results: The final model generated by hierarchical regression analysis revealed that MODQ scores included self-reported symptom aggravation with all movements, pain medication usage, average straight leg raise (SLR), pain intensity, and Fear-Avoidance Belief Questionnaire-Work (FABQ-W). Overall, these variables account for approximately 40% of variance. The mediational analysis indicated that the relationship between the FABQ-W and MODQ scores may be partially mediated by pain intensity, average SLR values and pain medication usage. Conclusion: In this correlational study of physical impairments, psychosocial factors and self-reported disability, disability was driven primarily by measures of pain and fear-avoidance beliefs. Because the FABQ is a simple and useful clinical tool, we suggest that physicians and physiotherapists alike should make it a routine attempt to characterise the fear-avoidance beliefs of patients with LBP.

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Introduction

Low back pain (LBP) is one of the most common problems in medical practice, affecting 70% to 80% of adults at some time during their lives.[1] Although most LBP episodes are self-limiting, the average individual has a long history of multiple episodes.[2] Consequently, LBP is a major public health problem with an immense socioeconomic burden in most developed countries. In Singapore, 3.9% of the patient presenting to designated factory doctors complained about symptoms of aches or pains in the back, neck or upper limbs. The commonest site affected was the back (55.7%), with the highest "medical certificate rate" (57.6%) among patients. These data also reflected a trend of increase yearly.[3]

In assessing disability in patients with LBP, it is recognised that self-report approaches have become well accepted in research,[4-7] as they are often seen as feasible and cost-effective means of gathering data on large numbers of individuals. Further, Guccione and colleagues[8] proposed that self-assessments are most consistent with the tenets of evidence-based practice,[9] requiring that a patient's values be conjoined to best clinical practice and clinically relevant research. Against this background, the modified Oswestry Low Back Disability Questionnaire (MODQ)[10] is a self-reported measurement of disability in patients with LBP. The MODQ includes 10 sections relating to questions about activities of daily living and pain. Each section, scored from 0 to 5 points, contains 6 statements that describe an increasing pain severity associated with a particular activity. Finally, the scores are summated and

[1] Department of Rehabilitation, Alexandra Hospital, Singapore
Address for Correspondence: Mr Cai Congcong, Department of Rehabilitation, Alexandra Hospital, 378 Alexandra Road, Singapore 159964.
Email: cong_cong_cai@alexhosp.com.sg

multiplied by 2 to provide a percentage of disability. The MODQ is commonly used in research and clinical practice[6,7,11] for the following reasons: (1) its measurements have high test-retest reliability (ICC = 0.90); (2) it possesses good construct validity, with correlations with global patient ratings and other region-specific disability measures over 0.80; and (3) it has good responsiveness in patients receiving physical therapy interventions for LBP.[12,13]

Disability in LBP may result from an interplay of personal psychosocial factors and impairments in body function.[4,6,14] In this regard, the International Classification of Functioning, Disability and Health (ICF) proposed by the World Health Organization (WHO)[15] can help organise the many variables that may influence disability experienced by patients with LBP. Within the ICF framework, impairments are problems in body function or structure such as significant deviation or loss.[15] Specifically, several cross-sectional studies have suggested that active flexion of the lumbar spine,[16] lower extremity muscle weakness,[16,17] balance disturbance,[16] reduction in the cross-sectional area and the force-generating capacity of lumbar muscles[18] are associated with disability.

With regard to psychosocial factors, a growing body of published data[19-22] has provided evidence that elevated pain-related fear predicted disability in patients with acute and chronic LBP. In individuals with LBP, the Fear-Avoidance Belief Questionnaire (FABQ) quantifies pain-related fears and beliefs about the need to change behaviour to avoid pain.[23] The FABQ has 16 items, each scored from 0 to 6; a higher number indicates a higher level of fear-avoidance beliefs. The FABQ comprises 2 subscales, the seven-item work (FABQ-W) and four-item physical activity (FABQ-PA) subscale respectively. The reliability of the FABQ-W and FABQ-PA has been reported to be high (ICC = 0.90 and 0.77, respectively).[24] Using the FABQ, longitudinal results from Al-Obaidi et al[4] showed that the FABQ-PA predicted a poor rehabilitation outcome in 42 subjects with chronic LBP who are not receiving worker's compensation. Similarly, Fritz and George[6] found that the FABQ-W predicted long-term work restriction. Collectively, the aforementioned studies indicate that a constellation of impairment and psychosocial measures are important correlates of disability in LBP.

We believe that identifying potentially modifiable determinants of disability in patients with LBP provides an opportunity to broaden the strategies to reduce its socioeconomic burden. To our knowledge, many studies have assessed the relationship of either impairment or psychosocial factors with disability, but few studies have comprehensively explored common clinical (office) measurements and personal psychosocial elements simultaneously. Moreover, there are minimal data in the literature describing the level of FABQ scores in the local clinical population, or the process by which the FABQ is associated with self-reported disability. Thus, we conducted a cross-sectional study with 2 aims: first, to examine the correlates of self-reported disability in patients with LBP; and second, to examine the level of FABQ scores in an ambulatory clinical population seeking physiotherapy management.

Materials and Methods

The 162 participants in this study had been referred from an orthopaedic outpatient clinic in a local hospital over 6 months. All participants had reviewed a diagnosis related to the lumbosacral spine, and had a chief complaint of pain and/or numbness in the lumbar spine, buttock, and/or lower extremity. All subjects gave their written consent allowing the release of test results for research purposes, as approved by a local hospital bio-ethics committee. Exclusion criteria were current pregnancy, signs of spinal cord injury, prior lumbar spine surgery, or a history of osteoporosis or spinal fracture. Subjects were not included in the data analysis if the clinician determined that the subject's symptoms were likely to be non-spinal origin.

Four physiotherapists working in the rehabilitation department of a local hospital participated in this study. A one-hour pre-study briefing was given, regarding study measures, introduction and ethics issues.

Basic demographic information were collected. These included gender, age, height, weight, education levels (primary, intermediary, graduate), smoking situation (smoker, non-smoker), onset duration (weeks), cause of pain (trauma, spontaneous, sudden), past history of episode, increase frequency episode, pain region (below or above knee), working environment (manual, desk bound, retired, unemployed), pain medication (yes or no), aggravating factors (sitting, standing, walking), and relieving factors (sitting, standing, walking).

All participants completed the MODQ[25] and FABQ.[23]

The visual analogue scale (VAS) measures pain intensity (0 to 10 cm; 0 indicates no pain, 10 indicates maximum pain). All participants completed the VAS by indicating average pain level during the pass 1 week for their judgement convenience.

The physiotherapists did a physical examination (PE) before the MODQ and FABQ were completed. The active lumbar flexion in standing was recorded as mid-thigh, patellar, mid-shin and distal shin. The bilateral straight leg raise (SLR) was measured by limitation of pain. The pain with SLR (kappa = 0.83) has acceptable reliability.[17] Posteroanterior spring testing[26] was performed for pain provocation and mobility at each lumbar level. Mobility was judged as normal, hypermobility, or hypomobility.

The deep tendon reflex test and manual muscle testing (MMT) were conducted. Patellar tendon and Achilles tendon reflex were rated as normal, hyper-reflexic, or hypo-reflexic. MMT (i.e., iliopsoas, quadriceps femoris, hamstring, peroneal, extensor hallucis longus, gastrocnemius, and tibialis anterior) was assessed to illustrate impairments suggestive of neural compression. The test results were dichotomised into the following categories: grade 5 and above were normal, while grade 4 or below as weakness. The agreement (kappa) between 2 orthopaedic surgeons in 50 patients with LBP was 0.65 to 1.00 for MMT, 0.23 to 0.39 for reflex.[27]

We examined the dependent variable, the score of the MODQ, as a continuous variable given its normal distribution. Pearson correlation coefficients were calculated to determine the relationship between the FABQ-W subscale and the following factors: age, height, weight, body mass index (BMI), symptom duration, average SLR, SLR difference, pain ratings and FABQ-PA. Point biserial correlations were calculated for binary independent variables comprising gender, smoking status, pain radiating below knee, medication usage and manual occupation. The Pearson and point biserial correlation coefficients were converted to coefficients of determination (R^2) to determine the strength of association between the aforementioned variables and the FABQ-W subscale. Eta squared was calculated to determine the strength of association between education status and lumbar flexion with scores from the FABQ-W.

Univariate linear regression analyses for continuous and ordinal independent variables were examined on the dependent variables. For binary independent variables, we used independent *t*-tests. All independent variables that met an initial statistical level of less than 0.15 were further examined in the multivariate analysis. Given the exploratory nature of this study and influence of the subsequent regression procedure, the inflated Type I error rate was determined to be acceptable.

A hierarchical multiple regression model was developed to predict the dependent variable, MODQ score. We first included all univariate predictors in the first block. Using a backward selection approach, variables not maintaining a significance level of at least $P = 0.10$ were removed from the model. Next, we force entered the fear-avoidance-beliefs variables (FABQ-W and FABQ-PA) in the second block so that their effects on MODQ scores could be determined after controlling for all other variables.

After the determination of regression equations, an investigation of possible violations of the normal model was performed with analysis of the residuals. We examined the assumptions of linearity and homogeneity of variance by plotting the residuals against the fitted values. We analysed the presence of possible influential points by inspecting the residual distribution. Multicollinearity amongst independent variables was investigated by examining the level of tolerance of each variable.

Finally, post-hoc analyses were performed to explore potential explanations for our findings. Specifically, we examined whether the FABQ-W scores were partially mediated by pain intensity, pain medication usage, average SLR values, and self-reported aggravation of symptoms with all movements, by using a product of coefficients strategy.[28,29] The coefficients were the regression coefficients from the FABQ-W-MODQ association and the adjusted mediator(s)-MODQ associations respectively. Because the sampling distribution of the product of coefficients may be skewed,[28,29] we generated 5000 bootstrap samples to produce the bias-corrected (BC) and BC accelerated (BCa) bootstrap confidence intervals.[30]

All statistical testing was performed with 2-tailed tests and at a 0.05 level of significance unless otherwise stated. We performed all statistical analyses using the SPSS software version 13.0 for Windows.

Results

Table 1 summarises the subjects' descriptive characteristics. Table 2 provides Pearson's correlation coefficients, coefficients of determination, and Eta^2 values for the relationships amongst the independent variables. Gender was found to be associated with the FABQ-W subscale ($r^2 = 0.04$, $P = 0.02$), with women exhibiting lower FABQ scores than men. Besides gender, variables such as age, average SLR, FABQ-PA, use of pain medication, manual work, and lumbar flexion were found to be associated with FABQ-W scores (r^2 ranged from 0.03 to 0.10). There were no significant associations between other independent variables and FABQ-W scores.

Based on the univariate analyses and *t*-tests, 10 variables met the initial selection criterion. They included self-reported increased frequency of pain episodes, pain medication usage, self-report that all movements (sitting, standing, and walking) aggravated symptoms, the presence of frank neurological signs, lumbar flexion in standing, average SLR, and differences in SLR values between sides, pain intensity, and FABQ scores.

Table 3 provides the results of the hierarchical regression analysis. The final model for modified MODQ scores included pain medication usage, average SLR, pain intensity, and FABQ-W. Overall, these variables account for approximately 40% of variance. The standardised beta coefficient and squared semipartial correlation coefficients indicated that pain intensity was the most influential variable in predicting the MODQ scores. Moreover, FABQ-W uniquely explained 3% of the variance, after controlling for

Table 1. Descriptive Statistics of the Sample (n = 162)

Variable	N	%	$\overline{X}$	Standard deviation	Median	Range
Sex						
Females	25	15.4	-	-	-	-
Males	137	84.6	-	-	-	-
Age (y)	162	-	30.6	11.4	27	17-68
Weight (kg)	162	-	69.4	13.2	68.2	42-109
Height (m)	162	-	1.71	0.07	1.71	148-198
Body mass index (kg/m^2)	162	-	23.7	3.9	23.3	15.9-35.1
Smoking status						
Smoker	49	30.2	-	-	-	-
Non-smoker	113	69.8	-	-	-	-
Education level						
High	72	44.4	-	-	-	-
Intermediate	86	53.1	-	-	-	-
Low	4	2.5	-	-	-	-
Duration (weeks)	162	-	43.26	108.67	19	1-1040
Mode of onset						
Gradual	68	42.0	-	-	-	-
Sudden	67	41.4	-	-	-	-
Traumatic	27	16.6	-	-	-	-
Prior history of low back pain (LBP) (%)	111	68.5	-	-	-	-
Episodes of LBP becoming frequent	61	37.7	-	-	-	-
Employment						
Manual work	93	57.4	-	-	-	-
Deskbound work	63	38.9	-	-	-	-
Use of pain medication	82	50.6	-	-	-	-
Sitting ranked as best position	62	38.3	-	-	-	-
Standing ranked as best position	26	16.0	-	-	-	-
Walking ranked as best position	33	20.4	-	-	-	-
No position relieves pain	41	25.3	-	-	-	-
Sitting ranked as worst position	57	35.2	-	-	-	-
Standing ranked as worst position	55	34.0	-	-	-	-
Walking ranked as worst position	41	25.3	-	-	-	-
All positions aggravate pain	9	5.5	-	-	-	-
Lumbar flexion						
Thigh level	6	3.7	-	-	-	-
Patella level	36	22.2	-	-	-	-
Mid-shin level	56	34.6	-	-	-	-
Distal shin level	64	39.5	-	-	-	-
Left straight leg raise (^{o})	162	-	65.02	18.52	70	20-110
Right straight leg raise (^{o})	162	-	66.20	18.24	70	20-100
Absolute difference in straight leg raise (^{o})	162	-	6.82	10.56	0	0-50
Symptom centralisation						
Lumbar flexion	94	58.0	-	-	-	-
Lumbar extension	42	25.9	-	-	-	-
None	26	16.1	-	-	-	-

Table 1. Contd.

Variable	N	%		Standard deviation	Median	Range
Hypomobility at one or more lumbar levels with spring testing	102	63.0	-	-	-	-
Pain at one or more lumbar levels with spring testing	142	87.7	-	-	-	-
Frank neurological signs	40	24.7	-	-	-	-
Pain intensity (Visual Analogue Scale)	162	-	5.60	1.733	6.0	2-9
Fear Avoidance Belief Questionnaire						
Work Subscale	162	-	21.36	10.35	22.00	0-42
Physical Activity Subscale	162	-	18.06	5.34	18.00	0-24
Modified Oswestry Disability Index	162	-	29.76	12.75	26.00	2-70

$\bar{x}$

Table 2. Association Between Independent Variables and Values from the FABQ-W Subscale in 162 subjects with Low Back Pain

Variable	r	r^2	Eta^2	*P*
Age	-0.30	0.088		<0.001*
Height	0.08	0.007		0.290
Weight	0.01	0.000		0.944
BMI	-0.04	0.001		0.655
Duration	-0.05	0.002		0.494
Average SLR	-0.25	0.061		0.002*
SLR difference	0.03	0.000		0.723
FABQ-PA	0.27	0.070		0.001*
Previous LBP	-0.01	0.000		0.90
Female	-0.19	0.04		0.02*
Smoking status	-0.07	0.005		0.36
Pain below knee	-0.03	<0.000		0.71
Pain intensity	0.18	0.03		0.02
Pain medication	0.16	0.03		0.045*
Manual work	0.32	0.10		<0.001*
Lumbar flexion	0.20†	—		0.01*
Education level	—	—	0.03	0.07
Pain medication	—	—	0.03	0.045*
Increased frequency	—	—	0.018	0.09
All movements aggravate	—	—	0.002	0.55

* Statistically significant at *P* <0.05.
† Spearman rho
BMI: body mass index; FABQ-PA: Fear-Avoidance Brief Questionnaire-Physical Activity; LBP: low back pain; SLR: straight leg raise

all other variables (Table 3).

We examined the final regression model for collinearity and heteroscedasticity. The tolerance values for all predictors were greater than 0.75 (0.77 to 0.93), indicating relatively low colinearity. Examination of plots of predicted values versus residuals indicated no discernible pattern (e.g., funnel) and thus no heteroscedasticity.

Table 4 shows the product of coefficients and the corresponding bootstrapped estimates of confidence interval from the mediational analysis. Only the BC and BCa confidence interval for self-reported aggravation of symptoms with all movements included zero, which indicates that the relationship between the FABQ-W and MODQ scores may be partially mediated by pain intensity, average SLR values and pain medication usage.

Discussion

In this study, we investigated the association between self-reported disability, as measured by the MODQ, and measurements commonly obtained in clinical practice. Further, we examined whether the variables retained in the multivariate analysis partially mediated the relationship between FABQ-W and MODQ scores. In our sample, the correlates of self-reported disability were self-reported symptom aggravation with all movements, average SLR, pain medication usage, pain intensity and FABQ-W (Table 3). We also found that the relationship between FABQ-W and MODQ may be partially mediated by the average SLR values, pain intensity and pain medication usage (Table 4). To our knowledge, the latter finding in individuals with LBP has not been previously reported.

In our study, although the lumbar-flexion variable was significantly associated with MODQ scores at the bivariate analysis, it was not retained in the final multivariate model. A modest correlation was found between lumbar flexion and pain-intensity scores (Spearman rho = 0.20). This finding suggests that lumbar flexion may be competing for predictive variance in the multivariate model. In our study, we attempted to mirror clinical practice by relying on anatomical landmarks to measure lumbar flexion. However, we believe our null finding is unlikely to be due to our use of an ordinal measure because previous cross-sectional[31,32] and longitudinal studies,[14] which measured lumbar flexion as a continuous variable, also did not find any association between lumbar flexion and self-reported disability. In

Table 3. Prediction of MODQ Scores in Patients with Low Back Pain (n = 162)

	Adjusted (R^2 = 0.40)			
Variable	**Regression coefficient (95% CI)**	**β (Final)**	**Semipartial r^2**	***P***
Intercept	12.6 (2.4 to 22.9)	NA	NA	0.016
All movements aggravate	10.6 (3.9 to 17.3)	0.19	0.04	0.002
Average SLR	-0.12 (-0.21 to -0.03)	-0.16	0.02	0.014
Pain medication	7.0 (3.8 to 10.2)	0.28	0.07	0.000
Pain intensity	2.4 (1.5 to 3.4)	0.33	0.09	0.000
FABQ-W	0.22 (0.06 to 0.38)	0.18	0.03	0.007
FABQ-PA	0.14 (-0.16 to 0.44)	0.06	0.004	0.37

Semipartial r^2 = square of the semipartial correlation coefficient indicates the unique variance accounted for by the individual independent variable.
95% CI: 95% confidence interval; FABQ-PA: Fear-Avoidance Brief Questionnaire-Physical Activity; FABQ-W: Fear-Avoidance Brief Questionnaire-Work; MODQ: modified Oswestry Low Back Disability Questionnaire; NA: not applicable; SLR: straight leg raise

Table 4. Bootstrapped Point Estimates, Confidence Intervals for the Relationship Between FABQ-W and MODQ Scores (n = 162)

	Bootstrapping				
Mediator	**Product of coefficients**	**BC 95%CI**		**BCa 95%CI**	
		Lower	**Upper**	**Lower**	**Upper**
Pain medication usage	0.053	0.005	0.12	0.0042	0.12
Average SLR	0.048	0.010	0.11	0.010	0.11
Pain intensity	0.073	0.01	0.16	0.01	0.16
All movements aggravate	-0.011	-0.080	0.027	-0.077	0.030

Bias-corrected (BC) and bias-corrected accelerated (BCa) confidence interval generated from 5000 bootstrapped samples
MODQ: modified Oswestry Low Back Disability Questionnaire; SLR: straight leg raise

contrast to our findings, other authors[33,34] have found statistically significant associations between lumbar flexion and self-reported disability. A direct comparison of our study with the aforementioned studies is difficult inasmuch as they did not include psychosocial variables in their multivariate analyses. Further, the bivariate correlations between the lumbar flexion AROM measure and disability were moderately low (<0.48), albeit statistically significant. Collectively, our findings and those of others suggest that lumbar flexion wields neither a strong nor unique role on self-reported disability.

Pain intensity and pain medication usage were influential predictors of disability in our sample. Although few would argue that pain and disability are orthogonal concepts, the MODQ is not a pure measurement of disability to the extent that its items included measures of pain and pain-related activity limitations (e.g., sitting, standing, walking and lifting).[35] Therefore, it is reasonable to question whether the high correlation between pain and MODQ may have masked the predictor capability of other variables. To address this issue, we repeated our stepwise regression and excluded the pain measures (pain intensity and pain medication usage) in our model. The regression model without pain explained 20% of the variation in self-reported disability, and FABQ-PA became significant in the final model (data not shown). Therefore, the argument to remove pain from the model to clarify the role of other measures has resulted in the emergence of an additional predictor.

Average SLR values were associated with self-reported disability in our sample. Although support for this finding can be found in the work by Waddell et al,[33] the construct validity of the average SLR values is not obvious. Ostensibly, hamstrings flexibility and neural mechanosensitivity could influence the magnitude of the average SLR. Given that the presence of frank neurological signs was associated with the average SLR values in our sample (eta = 0.18, P = 0.026), it could be anticipated that the presence of frank neurological signs may act through an impaired SLR range to increase disability.

The current study also found that aggravation of symptoms with all movements was associated with greater disability. These findings are heightened by the fact that only 5.6% of the total sample (n = 9) reported that all movements aggravated their pain; and despite this, the variable remained significant in this model. Although the relationship between symptom aggravation with all movements and disability is intuitively obvious, the supporting evidence in the literature is sparse. Because our mediator analysis revealed that this variable did not mediate the association between heightened fear-avoidance beliefs and disability, we suspect that it may be a mediator for an as yet unidentified or unmeasured factor.

The hierarchical modelling approach we used allowed us to examine the influence of fear-avoidance beliefs after controlling for all other impairment variables. As may be expected, fear-avoidance belief about work was a powerful predictor of disability; however, we did not find fear-avoidance belief about physical activity to be a correlate of disability. Several possibilities may help explain our latter finding. First, the strong association between pain and MODQ may have obscured the true association between the FABQ-PA scores and disability, as evinced by our post-hoc regression analysis. Second, 57% of our participants were involved in some form of manual work; hence, it is likely that their LBP was work-related. Regardless of these possibilities, this and other studies[14,19,23,36] have provided consistent evidence to support the notion that fear-avoidance beliefs exert its influence on disability over and above the other important correlates of disability.

While our results have suggested an empirical link between fear-avoidance beliefs and self-reported disability, we believe that exploring possible explanations on how a causal effect may occur is of equal scientific importance. To address this issue, our multiple-mediation analysis revealed that heightened fear-avoidance beliefs may increase self-reported disability by acting partially through pain intensity, pain medication usage, and an impaired average SLR range. Overall, our findings indicate that not only can fear-avoidance beliefs operate as a distinct construct; it can also wield a behavioural influence on other impairment measures.

That fear-avoidance beliefs can influence other correlates of disability is important. Although previous studies[14,19,37] have demonstrated an association between fear-avoidance beliefs, pain and disability measures, our findings stand on their own as new by linking the 3 constructs in a multiple mediational analysis. On the basis of our results, it appears that clinicians should pay attention to both fear-avoidance beliefs and pain when targeting these factors to reduce patients' disability level. Perhaps interventions such as coping strategies to deal with pain may be more effective in reducing disability than interventions aimed primarily at reducing pain as a symptom (i.e., modalities or analgesics). Indeed, intervention studies have shown that the judicious application of fear-avoidance–based physiotherapy management[36,38] and the use of an educational booklet[39] are efficacious in reducing the disability level of patients with heightened fear-avoidance beliefs.

Our study has several limitations. First, the gender distribution of our sample allowed us to confirm our findings in men, but not in women. Second, statements regarding causality cannot be made in this cross-sectional study. Third, our participants had been referred by their orthopaedic specialists to the physiotherapy outpatient department; hence, they may not be closely representative of the clinical population that is managed by general practitioners. Fourth, our finding of a statistically significant mediation effect does not necessarily support the direction or pattern of mediation.[29] However, we believe our results fit well into a theoretical framework[21,40] that would link an elevated level of fear-avoidance beliefs to an exaggerated pain perception.[21,40] Fifth, although 40% of the variance in disability were accounted for in this study, further research is needed to examine the extent to which other socio-economic, psychosocial and health-related factors not examined in this study explain the remaining 60% of the variance in disability. Ostensibly, other factors, including psychological distress, may be a more powerful correlate of disability than fear-avoidance beliefs.[41] Lastly, we selected the MODQ so that we could compare our results with those of other studies. However, we acknowledge that the MODQ may not be a strict measurement of participation restriction as defined in the WHO ICF model. Nonetheless, until an alternative questionnaire is shown to be consistently superior to the MODQ, all one can do is to acknowledge its shortcomings.

In this correlational study of physical impairments, psychosocial factors and self-reported disability, disability was driven primarily by measures of pain and fear-avoidance beliefs. Because the FABQ is a simple and useful clinical tool, we suggest that physicians and physiotherapists alike should make it a routine attempt to characterise the fear-avoidance beliefs of patients with LBP.

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REFERENCES

1. Biering-Sorensen F. A Prospective study of low back pain in a general population. I. Occurrence, recurrence, and etiology. Scand J Rehabil Med 1983;15:71-9.
2. Raspe HH. Back pain. In: Silman AJ, Hochberg MC, editors. Epidemiology of the Rheumatic Diseases. Oxford: Oxford University Press, 1993: 339-42.
3. Chan OY, Ho SF. Study on musculoskeletal complaints involving the back, neck and upper limbs. Singapore Med J 1998;39:363-7.

4. Al-Obaidi SM, Beattie P, Al-Zoabi B, Al-Wekeel S. The relationship of anticipated pain and fear avoidance beliefs to outcome in patients with chronic low back pain who are not receiving workers' compensation. Spine 2005;30:1051-7.
5. Cox ME, Asselins S, Gracovetsky SA, Richards MP, Newman NM, Karakusevic V, et al. Relationship between functional evaluation measures and self-assessment in nonacute low back pain. Spine 2000;25:1817-26.
6. Fritz JM, George SZ. Identifying psychosocial variables in patients with acute work-related low back pain: the importance of fear-avoidance beliefs. Phys Ther 2002;82:973-83.
7. Flynn T, Fritz J, Whitman J, Wainner R, Magel J, Rendeiro D, et al. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. Spine 2002;27:2835-43.
8. Guccione AA, Mielenz TJ, Devellis RF, Goldstein MS, Freburger JK, Pietrobon R, et al. Development and testing of a self-report instrument to measure actions: outpatient physical therapy improvement in movement assessment log (OPTIMAL). Phys Ther 2005;86:515-30.
9. Sackett DL, Strauss SE, Richardson WS. Evidence-based Medicine: How to Practice and Teach EBM. London, United Kingdom: Churchill Livingstone, 2000.
10. Fritz JM, Irrgang JJ. A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. Phys Ther 2001;81:776-88.
11. George SZ, Fritz JM, Erhard RE. A comparison of fear-avoidance beliefs in patients with lumbar spine pain and cervical spine pain. Spine 2001;26:2139-45.
12. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine 2000;25:2940-53.
13. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. Spine 2000;25:3115-24.
14. George SZ, Fritz JM, McNeil DW. Fear-avoidance beliefs as measured by the fear-avoidance beliefs questionnaire: change in fear-avoidance beliefs questionnaire is predictive of change in self-report of disability and pain intensity for patients with acute low back pain. Clin J Pain 2006;22:197-203.
15. World Health Organization. International Classification of Functioning, Disability and Health: ICF. Geneva, Switzerland: World Health Organization, 2001.
16. Iversen MD, Katz JN. Examination findings and self-reported walking capacity in patients with lumbar spinal stenosis. Phys Ther 2001;81: 1296-306.
17. Lyle MA, Manes S, McGuinness M, Ziaei S, Iversen MD. Relationship of physical examination findings and self-reported symptom severity and physical function in patients with degenerative lumbar conditions. Phys Ther 2005;85:120-33.
18. Kader DF, Wardlaw D, Smith FW. Correlation between the MRI changes in the lumbar multifidus muscles and leg pain. Clin Radiol 2000;55: 145-9.
19. Crombez G, Vlaeyen JW, Heuts PH, Lysens R. Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. Pain 1999;80:329-39.
20. Klenerman L, Slade PD, Stanley IM, Pennie B, Reilly JP, Atchison LE, et al. The prediction of chronicity in patients with an acute attack of low back pain in a general practice setting. Spine 1995;20:478-84.
21. Vlaeyen JW, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain 2000;85:317-32.
22. George SZ. Fear: a factor to consider in musculoskeletal rehabilitation. J Orthop Sports Phys Ther 2006;36:264-6.
23. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 1993;52:157-68.
24. Jacob T, Baras M, Zeev A, Epstein L. Low back pain: reliability of a set of pain measurement tools. Arch Phys Med Rehabil 2001;82:735-42.
25. Hudson-Cook N, Tomes-Nicholoson K, Hudson BA. A revised Oswestry disability questionnaire. In: *editors?* Back Pain: New Approaches to Rehabilitation and Education. New York: Manchester University Press, 1989.
26. Maher CG, Latimer J, Adams R. An investigation of the reliability and validity of posteroanterior spinal stiffness judgments made using a reference-based protocol. Phys Ther 1998;78:829-37.
27. McCombe PF, Fairbank J, Cockersole BC, Pynsent PB. Reproducibility of physical signs in low-back pain. Spine 1989;14:908-17.
28. MacKinnon DP, Lockwood, CM, Hoffman JM, West SG, Sheets V. A comparison of methods to test mediation and other intervening variable effects. Psychol Methods 2002;7:83-104.
29. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. Behav Res Methods Instrum Comput 2004;36:717-31.
30. Efron B, Tibshirani RJ. An Introduction to the Bootstrap. Boca Raton FL: Chapman & Hall, 1998.
31. Sullivan MS, Shoaf LD, Riddle DL. The relationship of lumbar flexion to disability in patients with low back pain. Phys Ther 2000;80: 240-50.
32. Nattrass CL, Nitschke JE, Disler PB, Chou MJ, Ooi KT. Lumbar spine range of motion as a measure of physical and functional impairment: an investigation of validity. Clin Rehabil 1999;13:211-8.
33. Waddell G, Somerville D, Henderson I, Newton M. Objective clinical evaluation of physical impairment in chronic low back pain. Spine 1992;17:617-28.
34. Deyo RA, Diehl AK. Measuring physical and psychosocial function in patients with low-back pain. Spine 1983;8:635-42.
35. Delitto A. Are measures of function and disability important in low back care? Phys Ther 1994;74:452-62.
36. George SZ, Fritz JM, Bialosky JE, Donald DA. The effect of a fear-avoidance-based physical therapy intervention for patients with acute low back pain: results of a randomized clinical trial. Spine 2003;28: 2551-60.
37. Asmundson GJ, Norton GR, Allerdings MD. Fear and avoidance in dysfunctional chronic back pain patients. Pain 1997;69:231-6.
38. Linton SJ, Boersma K, Jansson M, Svard L, Botvalde M. The effects of cognitive-behavioral and physical therapy preventive interventions on pain-related sick leave: a randomized controlled trial. Clin J Pain 2005;21:109-19.
39. Burton AK, Waddell G, Tillotson KM, Summerton N. Information and advice to patients with back pain can have a positive effect. A randomized controlled trial of a novel educational booklet in primary care. Spine 1999;24:2484-91.
40. Lethem J, Slade PD, Troup JD, Bentley G. Outline of a fear-avoidance model of exaggerated pain perception-I. Behav Res Ther 1983;21: 401-8.
41. Grotle M, Vollestad N, Brox JI. Clinical course and impact of fear-avoidance beliefs in low back pain: prospective cohort study of acute and chronic low back pain: II. Spine 2006;31:1038-46.