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Bodily pain and vitality are the key factors in the disability of chronic low back pain patients under Short Form 36 base study: a five-year cohort study

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Abstract

Background Chronic low back pain (CLBP), a significant cause of disability, is expected to increase with aging. Short Form 36 (SF-36) indicated higher baseline component scores predict CLBP disability at shorter follow-ups, with unexplored five-year associations. The study aimed to test the associations of the physical and mental subscales of the SF-36 at baseline with disability at the five-year follow-up point among patients with CLBP.

Methods Patients aged between 20 and 65 years with CLBP were enrolled at baseline and followed at the five-year point. The Oswestry Disability Index (ODI), the physical functioning (PF) subscale of the SF-36, and self-reported total months of disability (TMOD) over the past five years were used as the indices of disability. The four physical and mental subscales of the SF-36 were used as independent factors, respectively. Multiple linear regression was used to compare the associations of the physical and mental subscales at baseline with disability at follow-up.

Results Two hundred twenty-five patients with CLBP were enrolled at baseline and 111 participated in followed at the five-year point. Among the SF-36 subscales, the scores of bodily pain (BP), vitality (VT), and social functioning (SocF) at baseline were significantly correlated with the three indices of disability at follow-up. After controlling for demographic and clinical variables, BP and VT at baseline were most strongly associated with the ODI and TMOD at follow-up among the four physical and mental subscales, respectively. PF at baseline was most strongly associated with itself at follow-up among the four physical subscales.

Conclusion Our results demonstrated that both the physical and mental subscales of the SF-36 at baseline could predict disability at the five-year follow-up point among patients with CLBP. The BP and VT subscales were independent factors associated with disability among the physical and mental subscales, respectively.

Keywords Quality of life, Disability, Chronic Low Back Pain, Short Form 36

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Background

Chronic low back pain (CLBP) is the leading cause of disability, affecting people from children to the elderly [1], and will likely increase further with population aging [2]. Some systematic reviews [3–7] and studies [8–11] showed a range of factors predictive of disability and poor outcomes, including work environment, psychological distress, depressive mood, older age, more social dysfunction and isolation, heavier work, being non-employed, having widespread pain, a high level of chronic pain grade, catastrophizing, fear-avoidance belief, as well as higher pain intensity. A recent study [12] also reported that pain severities rated by the visual analogue scale (VAS) and numeric rating scale (NRS) were positively correlated with a disability rated by the Modified Oswestry Disability Index among patients with CLBP. It indicated that the VAS and NRS were associated with disability among patients with CLBP.

Considering the multidimensional nature of CLBP, assessing a broad range of physical, psychological, social, and health-related quality of life (HRQoL) measures was recommended [13]. Some studies [14–16] have used the degree of disability, social stress, or depression scores to predict HRQoL among patients with CLBP. Conversely, one study investigated the power of the HRQoL to predict disability among patients with CLBP [17]. Another study tested the associations of clinical variables of CLBP at baseline with disability at the one-year and five-year follow-up points [18].

The 36-item Short Form Health Survey questionnaire (SF-36) is a widely used tool for evaluating HRQoL and has been used in many populations with good reliability and validity [19, 20]. A previous study demonstrated that higher scores of physical and mental component summaries on the SF-36 at baseline were predictors of disability among patients with CLBP at 5-month and 12-month follow-up points [17]. However, the total scores of physical and mental component summaries were unable to present the exact power of individual subscales to predict disability. Moreover, 5-month and 12-month follow-ups were short-term durations for the prognosis of CLBP. To our knowledge, no study has tested the associations of SF-36 subscales at baseline with disability at a five-year follow-up point among patients with CLBP. This study was important because early intervention may avert the development of disability [21, 22]. If the scores of the SF-36 subscales at baseline could predict disability at long-term follow-up points among patients with CLBP, it will be a useful index for early intervention.

Therefore, this study aimed to test the associations of the four physical and mental subscales of the SF-36 at baseline with disability at the five-year follow-up point among patients with CLBP. We hypothesized that both the physical and mental subscales of the SF-36 at baseline could predict disability at the five-year follow-up point among patients with CLBP.

Methods

Study design and participants

The program was an observational study. Treatment strategies were not controlled. At baseline (from August 2008 to November 2010), this study was performed in the general orthopedics clinic of the Chang Gung Memorial Hospital at Linkou, a medical center in Taiwan. Patients were considered eligible if they 1) were 20–65 years of age, 2) had made a first visit to our orthopedics clinic, and 3) had suffered from low back pain (LBP) for at least three months. The exclusion criteria were if patients had 1) psychotic symptoms, intellectual disability encoded by the Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM-IV-TR) [23], or severe cognitive impairment with apparent difficulty being interviewed. Trained medical investigators were present to evaluate whether patients could understand and complete the questionnaires, and 2) taken antidepressants or antipsychotics within the past four weeks. After enrollment, physical examinations were performed by a board-certified orthopedist.

These patients were treated as general outpatients in orthopedics clinics. During the five years, some of the outpatients quit treatment due to improvement or other reasons. Past histories of surgical operations for CLBP were recorded as an independent variable.

The five-year follow-up investigation was performed from August 2013 to July 2015. The Institutional Review Board approved the study of the same hospital (IRB Number: 101-4738B). Before study enrollment, written informed consent, based on the guidelines regulated in the Declaration of Helsinki, was obtained from all study participants.

Measures

Assessment of quality of life

The SF-36, which includes 36 items, is a self-reported questionnaire to measure HRQoL [20, 24][. In this study, the acute version of the SF-36, which evaluates HRQoL in the past week, was used [25]. The SF-36 was divided into eight domains and categorized into four physical subscales, including physical functioning (PF), role limitations-physical (RP), bodily pain (BP), and general health perceptions (GH), and four mental subscales, including vitality (VT), social functioning (SocF), role limitations-emotional (RE), and mental health (MH). Every domain can be scored from 0 (lowest well-being) to 100 (highest well-being) [24].

For evaluation of the average pain intensity of LBP in the past week, the visual analogue scale (VAS), with 0 representing "no pain" and 10 representing "pain as severe as I can imagine", was used.

Assessment of disability

In the study, three indices of disability, including the Oswestry Disability Index (ODI), the PF subscale of the SF-36, and self-reported total months of disability (TMOD) due to CLBP over the past 5 years, were used.

The Oswestry Disability Questionnaire includes 10 items for evaluating back or leg pain-related disability in daily life [26]. The questionnaire includes questions about pain intensity, lifting, ability to care for oneself, ability to walk, ability to sit, sexual function, ability to stand, social life, sleep quality, and ability to travel [27]. The score of the questionnaire ranged from 0 to 50 and was multiplied by 2 to become a percentage score. In this study, we used ODI at baseline as an independent variable because the ODI helps researchers quantify disability related to LBP. Additionally, the ODI was used as the primary outcome because it is the most used outcome-measure questionnaire for LBP [28].

The PF subscale of the SF-36 included 10 items, which evaluate the limitation of daily activities due to physical problems. A lower score on the PF subscale represented more limitations due to physical problems. Therefore, the PF score could be considered an index of disability due to CLBP in this study.

The study participants were requested to report TMOD, defined as the total duration of disability in jobs and/or domestic work due to CLBP over the past five years. The self-reported TMOD was used because the ODI and the PF subscale evaluated the severity of disability in recent daily activities at the follow-up point and the TMOD represented the total duration of disability over the past five years.

Statistical methods

All statistical analyses were performed using SPSS for Windows 20.0 [29]. The Chi-square test, independent t-test, and Pearson's correlation were used appropriately. To determine the associations of the SF-36 subscales at baseline with the three disability indices at the follow-up point, two models of multiple linear regression with the Forward method were employed. Models I and II tested the associations of the four physical subscales and the four mental subscales at baseline with the three indices of disability among patients with CLBP, respectively, at the follow-up point. In the two models, the dependent variables were the three disability indices, including the ODI, PF subscale, and TMOD at the follow-up point. In the first model, the independent variables included five demographic variables (gender, age, educational years, employment status, and marital status) at baseline, obesity (body mass index ≥ 27) at baseline, pain intensity (VAS) at baseline, ODI at baseline, the scores of the four physical subscales at baseline, and with a past surgical history for LBP at follow-up or not. In the second model, the independent variables included the same independent variables as in the first model, except that the four physical subscales were replaced by the four mental subscales. Past surgical history for LBP at follow-up was put as an independent factor because surgery is one of the important treatments for CLBP and might have obvious impacts on the outcome of CLBP.

A two-tailed test with a $p\text{-}value < 0.05$ was considered to indicate statistical significance in all statistical analyses.

Results

Study participants

At baseline, 225 patients agreed to participate. At the five-year follow-up point, 111 patients, including 46 women and 65 men, completed the datasets. Among the 114 (50.7%) patients without follow-up, 35 (15.6%) could not be contacted by phone or mail and 79 (35.1%) refused to participate in the follow-up program. The demographic variables, pain intensity, ODI, and scores of the SF-36 at baseline and follow-up are presented in Table 1. At the five-year follow-up point, the TOMD was 9.1 ± 17.5 months among the patients with follow-up. "Every subscale of the SF-36 can be scored from 0 (lowest well-being) to 100 (highest well-being)

There was no significant difference in the five demographic variables, VAS scores, ODI, the percentage of past surgical history and obesity, and scores of the eight SF-36 subscales between patients with and without follow-up at baseline, except for marital status ($p=0.04$) and the scores of the RE ($p=0.03$) and MH ($p=0.03$) (Table 1). Among the 111 patients with follow-up, there were significant decreases in the scores of the VAS and ODI at follow-up as compared with those at baseline. Moreover, all the scores of the SF-36 subscales were significantly increased at follow-up as compared with those at baseline, except for the scores of the VT ($p=0.08$) and RE ($p=0.36$). The percentage of past surgical history also was significantly increased at follow-up as compared with that at baseline.

Correlations of the three indices of disability at the 5-year follow-up point with the scores of the SF-36 subscales at baseline

The correlations of the three indices of disability at follow-up with the scores of the SF-36 subscales at baseline are presented in Table 2. All scores of the four physical

Table 1 Demographic variables and scores of the Short Form 36 at baseline and follow-up

	Baseline Total (*n* =225)	Baseline Without follow-up (*n* =114)	Baseline With follow-up (*n* =111)	Follow-up With follow-up (*n* =111)
Age (years)	40.7±11.4	39.7±11.1	41.7±11.7	46.7±11.8**
Years of education[a]	11.4±3.4	11.1±3.3	11.6±3.4	11.6±3.4
Female (%)	103(45.8)	57(50.0)	46(41.4)	46(41.4)
Male (%)	122(54.2)	57(50.0)	65(58.6)	65(58.6)
Married (%)	69.3	63.2*	75.7	79.3
Employment (%)	67.6	68.4	66.7	69.4
Obesity (BMI ≥ 27; %)	20.9	19.3	22.5	27.0
Past surgical history (%)	5.3	3.5	7.2	25.2**
ODI[b]	31.4±15.3	32.0±16.2	30.8±14.4	18.3±14.4**
Pain intensity (VAS)[c]	5.7±2.7	5.8±2.6	5.7±2.7	2.6±2.7**
Subscales of SF-36[d]				
PF	67.8±20.8	68.9±19.7	66.7±21.8	76.5±20.6**
RP	31.0±37.9	32.0±36.7	30.0±39.3	52.3±44.0**
BP	46.2±16.9	46.3±16.6	46.0±17.3	64.0±20.7**
GH	47.9±22.4	47.1±21.6	48.7±23.4	62.5±14.1**
VT	50.6±23.9	47.8±23.1	53.5±24.5	57.1±22.2
SocF	68.4±24.2	67.2±24.6	69.6±23.8	77.4±22.0**
RE	53.8±43.8	47.4±45.0*	60.4±41.8	64.6±42.0
MH	61.3±22.1	58.2±23.0*	64.5±20.8	68.8±19.3*

ODI Oswestry Disability Index, *BMI* Body mass index, *PF* Physical functioning, *RP* Role limitations-physical, *BP* Bodily pain, *GH* General health perceptions, *VT* Vitality, *SocF* Social functioning, *RE* Role limitations-emotional, *MH* Mental health, *VAS* Visual analogue scale

* $p < 0.05$

** $p < 0.01$

[a] " Years of education" was defined as the number of academic years a person completed in a formal education program, which started from elementary school

[b] The ODI score is ranged from 0-100. A higher score means a greater disability." "Every subscale of the SF-36 can be scored from 0 (lowest well-being) to 100 (highest well-being)

[c] Pain intensity was evaluated using a 0–10 visual analogue scale

[d] Every subscale of the SF-36 can be scored from 0 (lowest well-being) to 100 (highest well-being)

subscales were significantly correlated with the scores of the ODI and PF at follow-up, except for the correlation of the GH score at baseline with the ODI score. All scores of the four mental subscales were significantly associated with the scores of the ODI and TMOD at follow-up, except for the correlation of the RE score at baseline with the ODI score. Among the eight subscales of the SF-36, the scores of the BP, VT, and SocF at baseline were significantly associated with the three indices of disability at follow-up.

Age, pain intensity, and ODI at baseline were significantly correlated with the ODI and PF scores at follow-up. Educational years at baseline were significantly correlated with the three indices of disability at follow-up.

Independent factors associated with the three indices of disability

Tables 3, 4, and 5 show the independent factors associated with ODI, PF, and TMOD, respectively. As shown in Table 3, age and BP, as well as age and VT at baseline, were significant independent factors associated with ODI at follow-up in models I and II, respectively. Models I and II could explain 20% and 21% of the variance in the ODI score at follow-up, respectively.

As shown in Table 4, PF score and age, as well as ODI score and age at baseline, were significant independent factors associated with the PF score at follow-up in models I and II, respectively. Models I and II could explain 22% and 14% of the variance in the PF subscale at follow-up, respectively.

As shown in Table 5, educational years and BP score, as well as educational years and VT score at baseline, were significant independent factors associated

Table 2 Correlations of the Short Form 36 subscales at baseline with the indices of disability at follow-up[a]

	$ODI_{(5Y)}$	$PF_{(5Y)}$	$TMOD_{(5Y)}$
$Age_{(B)}$	0.31**	−0.26**	0.13
Educational $years_{(B)}$	−0.28**	0.20*	−0.32**
Pain $intensity_{(B)}$[b]	0.22*	−0.20*	0.09
$ODI_{(B)}$	0.28**	−0.31**	0.18
Subscales of SF-36			
$PF_{(B)}$	−0.19*	0.40**	−0.11
$RP_{(B)}$	−0.23*	0.28**	−0.10
$BP_{(B)}$	−0.30**	0.33**	−0.23*
$GH_{(B)}$	−0.15	0.23*	−0.18
$VT_{(B)}$	−0.28**	0.21*	−0.26**
$SocF_{(B)}$	−0.23*	0.26**	−0.23*
$RE_{(B)}$	−0.13	0.05	−0.20*
$MH_{(B)}$	−0.26**	0.18	−0.22*

ODI Oswestry Disability Index, *PF* physical functioning, *RP* role limitations-physical, *BP* bodily pain, *GH* general health perceptions, *VT* vitality, *SocF* social functioning, *RE*, role limitations-emotional, *MH* mental health, *TMOD* Self-reported total months of disability over the past 5 years

* $p<0.05$

** $p<0.01$

[a] "B" and "5Y" indicate data collected at baseline and the 5-year follow-up point, respectively

[b] Pain intensity was evaluated using a 0–10 visual analogue scale

Table 3 Independent factors at baseline associated with the Oswestry Disability Index at follow-up[a]

Model	Independent variables	Standardized Beta	*t*	R^2 change	*p-value*
I	Age	0.32	3.65	0.10	< 0.001
	BP	−0.31	−3.58	0.10	0.001
II	Age	0.35	4.05	0.10	< 0.001
	VT	−0.33	−3.77	0.11	< 0.001

BP Bodily pain subscale of the Short Form 36, *VT* Vitality subscale of the Short Form 36

[a] Models I and II tested the associations of the four physical and mental subscales of the Short Form 36 at baseline with the Oswestry Disability Index at follow-up, respectively

Table 4 Independent factors at baseline associated with the PF score of the SF-36 at follow-up[a]

Model	Independent variables	Standardized Beta	*t*	R^2 change	*p-value*
I	PF	0.38	4.50	0.16	< 0.001
	Age	−0.24	−2.75	0.06	< 0.01
II	ODI	−0.27	−2.95	0.10	< 0.01
	Age	−0.21	−2.32	0.04	0.02

PF Physical functioning subscale of the Short Form 36, *ODI* Oswestry Disability Index

[a] Models I and II tested the associations of the four physical and mental subscales of the Short Form 36 at baseline with PF score at follow-up, respectively

with TMOD over the past five years in models I and II, respectively. Models I and II could explain 16.0% and 18.0% of the variance in the TMOD at follow-up, respectively.

The variance inflation factors in the models I and II were 1.0 and 1.02 for the Table 3, 1.01 and 1.04 for the Table 4, and 1.0 and 1.01 for the Table 5, respectively.

Discussion

The study aimed to investigate the associations of the four physical and mental subscales of the SF-36 at baseline with disability at the five-year follow-up point among patients with CLBP. This study found that several factors at baseline, including the BP, PF, and VT subscales, ODI, age, and educational years, were associated with the indices of disability at the five-year follow-up point. Among the four physical subscales, BP score at baseline was most strongly associated with ODI and TMOD at follow-up and PF score at baseline was associated with itself at follow-up. Among the four mental subscales, the VT score at baseline was most strongly associated with ODI and TMOD at follow-up.

The multiple linear regression models showed that several factors, including the BP, PF, and VT subscales, ODI, age, and educational years, were significantly associated with the three indices of disability at the five-year follow-up point. Among the four physical subscales, BP score at baseline was most strongly associated with ODI and TMOD at follow-up and PF score at baseline was associated with itself at follow-up. Among the four mental subscales, the VT score at baseline was most strongly associated with ODI and TMOD at follow-up.

In this study, the BP score at baseline was significantly correlated with all three indices of disability at follow-up (Table 2).The BP subscale having a higher association with disability at follow-up might result from the fact that it evaluated both pain intensity and functional impairment due to pain. Several previous studies also reported that pain intensity was an important factor associated with disability [8, 9, 12, 14]. Grotle et al. found that a high level of chronic pain grade increased the risk of high disability at the 12-month follow-up point [8].

The VT score at baseline was a significant factor associated with the ODI and TMOD at follow-up. The VT subscale included four items and assessed both energy and fatigue. Our results highlighted the interesting finding that the VT subscale at baseline had a higher association with disability at follow-up than the MH subscale, which evaluated depression and anxiety. Several previous studies found that depression and anxiety were closely associated with disability [30–33] among patients with CLBP. Study participants with a lower VT score might imply that the patient suffers from fatigue, lack of motivation,

Table 5 Independent factors at baseline associated with the total months of disability over the past 5 years[a]

Model	Independent variables	Standardized Beta	*t*	R^2 change	*p-value*
I	Educational years	−0.34	−3.85	0.10	< 0.001
	BP	−0.25	−2.84	0.06	< 0.01
II	Educational years	−0.34	−3.93	0.10	< 0.001
	VT	−0.29	−3.27	0.08	0.001

BP Bodily pain subscale of the Short Form 36, *VT* Vitality subscale of the Short Form 36

[a] Models I and II tested the associations of the four physical and mental subscales of the Short Form 36 at baseline with the total months of disability over the past 5 years, respectively

and an exhausted feeling. Lack of motivation and fatigue are diagnostic criteria for major depressive disorder in the DSM-5 [34] and might be more difficult to recover from than mood symptoms and become residual symptoms of major depressive disorder [35]. Our results also showed that the improvement in the VT score was insignificant ($p=0.08$) (Table 1) at follow-up. The concept of the VT subscale differs from anxiety and depression, especially in terms of stress-related exhaustion [36]. Our results were compatible with previous studies [37–39]. A lower level of vitality was associated with disability [37] and was a significant independent predictor of disability [38].

Several points were worth noting: 1) Table 2 shows that all four mental subscales were significantly correlated with TMOD over the past five years. This might imply that the mental dimension of the SF-36 was more associated with a total duration of disability in the long-term follow-up as compared with the physical dimension. Previous studies also reported that psychological factors such as anxiety, depression, or distress predicted disability among patients with CLBP [5–7, 10]. 2) Years of education were an independent factor for TMOD and significantly correlated with the three indices of disability at follow-up. Previous studies reported that less well-educated people were more likely to be affected by LBP due to increased susceptibility or impairment of adaptation to illness [9, 40, 41]. Moreover, disability due to LBP is over-represented among people with low socioeconomic status [42]. 3) Age was an independent factor associated with ODI and PF at follow-up. Several previous studies reported that older age was associated with worse functional disability among patients with CLBP [11, 43, 44]. 4) The PF score at baseline was correlated ($r=0.40$, $p<0.01$) with that at follow-up. In Table 1, the PF score was increased at follow-up, compared with that at baseline. This meant that physical functioning was improved at follow-up. This might partially result from treatment of CLBP and improvement of pain intensity. 5) Social function at baseline was negatively correlated with ODI and TMOD at follow-up. This meant that a better social function at baseline was associated with less disability at follow-up. Previous studies reported that a higher social function is likely to receive more emotional support and exhibit better baseline performance [45] and dissatisfaction with social support was linked to increased challenges in performing activities of daily living and instrumental activities of daily living [46].

Limitation

There were limitations of our study. 1) This study was observational. Although past surgical history was put into the regression model, other therapeutic methods were not controlled. This might cause bias. 2) The TMOD, which was self-reported data, might have memory bias. 3) Only about half of the study participants at baseline participated in the follow-up study. Although there were no significant differences in the five demographic variables, VAS score, ODI, percentage of past surgical history, and scores of the eight SF-36 subscales between patients with and without follow-up at baseline, patients with follow-up had higher scores in the RE and MH at baseline, compared with those without. This might cause bias because patients without follow-up had a poorer HRQoL in the RE and MH. 4) The study enrolled study participants from one medical center. Expansion of our results to the general population should be performed cautiously.

Conclusion

In conclusion, our results demonstrated that the SF-36 subscales at baseline were associated with disability at the five-year follow-up point among CLBP patients. The BP and VT subscales at baseline were most strongly associated with ODI and TMOD at follow-up among the four physical and mental subscales, respectively. The PF subscale at baseline was most strongly associated with itself at follow-up among the four physical subscales. The results implicated that improvements in pain intensity, vitality, and physical functions might be important in preventing patients with CLBP from becoming disabled. Further studies should investigate the mechanisms that

could explain the associations between these SF-36 subscales and the indices of disability. Moreover, whether our findings could extend to the general population should be more investigated.

Abbreviations

BMI	Body Mass Index
BP	Bodily pain
CLBP	Chronic low back pain
DSM	Diagnostic and Statistical Manual of Mental Disorders
GH	General health perceptions
MH	Mental health
NRS	Numerical Rating Scale
ODI	Oswestry Disability Index
PF	Physical functioning
RE	Role limitations-emotional
RP	Role limitations-physical
SF-36	Short Form 36
SocF	Social functioning
TMOD	Self-reported total months of disability over the past 5 years
VAS	Visual Analogue Scale
VT	Vitality

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Authors' contributions
CIH, WCC, and HLL contributed to the study conception and design. CIH, HLL, WCC, and TSF performed material preparation, data collection, and analysis. HLL and WYC wrote the first draft of the manuscript. WYL revised the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This was an observational study and was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Review Board of Chang Gung Memorial Hospital (IRB Number: 101-4738B). Informed consent was obtained from all participants before participation.

Consent for publication
The findings described in this document have not been previously published, and none of the authors are currently submitting them to another publisher for consideration.

Competing interests
The authors declare no competing interests.

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