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Self-Management Behaviors for Chronic Low Back Pain in Patients with Spinal Disease: A Structural Equation Modeling Analysis

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Purpose: The purpose of this study was to construct and test a hypothetical model of self-management behavior in patients with chronic low back pain based on the results of previous studies and a literature review. **Methods:** Data from 218 outpatients with spinal disease who visited a university hospital from January 21 to August 3, 2021 with chronic back pain that had lasted for more than 3 months were collected and analyzed. **Results:** The goodness-of-fit of the final model satisfied recommendations (RMR=.01, RMSEA=.07, GFI=.97, NFI=.95, TLI=.92, CFI=.97). Negative illness perception directly and negatively influenced self-management behavior (β=-.15, *p*=.021), and also indirectly affected self-management behavior through self-efficacy (β=-.07, *p*=.007). Positive illness perception directly exerted a positive impact on self-management behavior. Active participation, internal health control, and self-efficacy all directly influenced self-management behavior. **Conclusion:** In order to improve self-management behavior in patients with chronic low back pain and spinal diseases, it is crucial to first determine whether the patient's perception of their illness is positive or negative. Patients should be encouraged to adopt a positive attitude towards their condition and to persist with self-management.

Key Words: Low back pain; Self management; Behavior; Perception

INTRODUCTION

As industrialization advances, the incidence of low back pain is increasing. Historically, it was most common among laborers who frequently lifted heavy objects. However, in recent times, it has become increasingly prevalent among drivers and office workers who spend extended periods using computers, due to sustained and repetitive postures. According to a study on the burden of disease in Koreans by the Korea Centers for Disease Control and Prevention (2020), low back pain accounts for the greatest disease burden in women and the second-greatest in men, marking it as a significant health issue. Chronic low back pain, which persists for at least 3 months, refers to pain that does not fully subside even with temporary treatment [1].

Chronic low back pain can be broadly divided into two categories: non-specific low back pain with an unknown cause, and low back pain linked to degenerative changes in the spine. Spinal conditions associated with this type of pain include intervertebral disc herniation, spinal stenosis, and spondylolisthesis. These conditions are responsible for 50~70% of patients who seek treatment at comprehensive or higher-level spine centers, as well as neurosurgery and orthopedic outpatient departments [2,3]. Common symptoms extend beyond low back pain to include leg numbness, weakness in the lower extremities, muscle weakness, and gait disturbances, all of which can lead to physical disabilities. These disabilities can interfere with daily life and work activities, potentially leading to psychological issues such as depression, feelings of helplessness, and social isolation [1]. These psychological problems can not only intensify pain, but also complicate the management of low back pain by reducing the patient's motivation to participate in treatment. Moreover, the physical disabilities and psychological issues associated with low back pain can create a vicious cycle of chronicity, ad-

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versely affecting quality of life and overall life satisfaction [3,4]. In 2019, the annual number of inpatient admissions for chronic low back pain resulting from spinal disease reached 264,178, and medical expenses rose by 12.3% compared to 2018, totaling 331.4 billion won [5]. The number of operations is also increasing each year, leading to significant societal and economic impacts, including workforce losses and escalating healthcare costs [6,7]. Given the high incidence and recurrence of chronic low back pain, along with the associated high healthcare costs, medical societies are emphasizing the importance of self-management for pain relief and prevention of recurrence in order to reduce medical expenses.

Self-management of chronic low back pain is closely related to everyday activities such as maintaining correct posture, engaging in exercises to strengthen back muscles, maintaining a healthy weight, and abstaining from smoking. The role of patients with spinal disease is pivotal in this context. Self-management is defined as the active participation of patients in making suitable decisions and executing tasks and skills with a sense of self-efficacy to engage in health-oriented behaviors [8]. Enhanced self-management strategies and support have been identified as crucial for managing chronic low back pain [9]. Furthermore, self-management by patients with spinal disease who suffer from chronic low back pain has resulted in pain reduction, significant improvements in preventing low back pain recurrence, and a decrease in healthcare costs [1]. However, despite the importance of self-management for chronic low back pain, the initial vigilance that patients feel when they first experience back pain tends to diminish over time. Consequently, the self-management behavior of patients with spinal disease is not consistently maintained, but rather remains temporary, leading to worsening low back pain and frequent recurrences [1]. Improving self-management skills for chronic low back pain is a necessity for patients with spinal disease, and healthcare professionals, including doctors and nurses, should provide the necessary medical services to improve these patients' self-management abilities. Therefore, it is essential to identify the factors that influence the active performance and maintenance of self-management behaviors in patients with spinal disease suffering from chronic low back pain, and to establish effective intervention strategies based on this understanding.

Research conducted in Korea has identified several factors related to self-management behaviors for chronic low back pain. These include the health perception of chronic low back pain [10], knowledge about low back pain [11, 12], motivation [13], self-efficacy [4], pain perception [12-14], and depression [13,14]. International research has also highlighted factors such as disease recognition [9], knowledge about low back pain [15], education [16], support and advice from healthcare professionals [16], self-efficacy [15, 17], and belief in treatment effectiveness [15] as having a positive impact on self-management behaviors for chronic low back pain. However, most previous studies have primarily focused on examining the relationship between one or two related factors and self-management behavior variables of chronic low back pain. Comprehensive research exploring self-management behaviors and their influencing factors is relatively scarce. Therefore, to enable patients with spinal disease to actively engage in and maintain self-management behaviors for chronic low back pain, there is a need for research that thoroughly elucidates the relationships and pathways between factors related to the adherence and maintenance of self-management behaviors among patients with chronic low back pain.

Therefore, in this study, we aimed to construct a model that can explain and predict the pathways of self-management behaviors for chronic low back pain in patients with spinal disease and to identify the factors influencing these self-management behaviors. The purpose of this study was to construct a structural model that identifies the factors influencing self-management behavior in patients with spinal disease in their daily lives, with the ultimate goal of improving these behaviors and preventing the decrease and recurrence of low back pain in daily life. The specific goals were to propose a hypothetical model of self-management behaviors for chronic low back pain in patients with spinal disease, validate the fit of this hypothetical model with real-world data, verify the direct and indirect effects of factors that influence self-management behaviors, and clarify their reciprocal causal relationships.

1. Conceptual Framework and Hypothetical Model of the Study

Based on previous research findings and a literature review, this study aimed to identify the factors that influence self-management behaviors for chronic low back pain in patients with spinal disease and to clarify the causal relationships among these factors. The conceptual framework of this study included negative disease perception, positive disease perception, back pain-related knowledge, active participation, internal health control, and self-efficacy (Figure 1).

First, illness perception can directly influence self-management behaviors and can also indirectly affect them

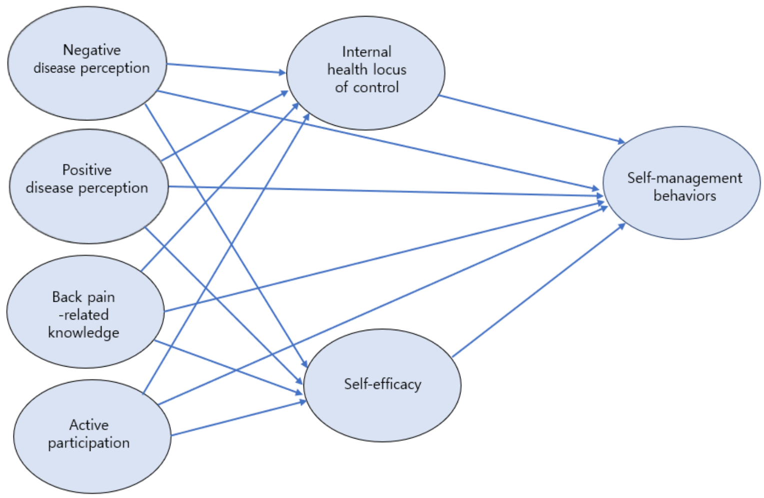


Figure 1. Conceptual framework for this study.

through internal health control and self-efficacy. The perception of disease, whether negative or positive, has been found to influence self-management behaviors. A negative perception of disease negatively impacts internal health control, self-efficacy, and self-management behaviors [18-20], while a positive perception of disease has a positive impact. Consequently, in this study, disease perception was categorized into negative and positive perceptions [18] and established as external variables. Second, back pain-related knowledge can directly influence self-management behaviors and can also indirectly affect them through internal health control and self-efficacy. In essence, a higher level of knowledge about low back pain is associated with higher internal health control, self-efficacy, and self-management behaviors [12,15]. Third, active participation can directly influence self-management behaviors and can also indirectly affect them through internal health control and self-efficacy [21]. Fourth, internal health control can directly influence self-management behaviors. Higher levels of internal health control are associated with higher self-management behaviors [22,23]. Fifth, self-efficacy can directly influence self-management behaviors. It has been observed that higher self-efficacy leads to increased self-management behaviors [15]. In this study, we established a hypothetical model to investigate the factors that influence self-management behaviors in patients with spinal disease experiencing chronic low back pain. The endogenous variables in this model are internal health control, self-efficacy, and self-management behaviors. Conversely, the exogenous variables are negative disease perception, positive disease perception, back pain-related knowledge, and active participation. This hypothetical model served as the basis for the following hypotheses.

1) Hypotheses with self-management behaviors as endogenous variables

- Hypothesis 1: Higher scores in negative disease perception will lead to lower scores in self-management behaviors.
- Hypothesis 2: Higher scores in positive disease perception will result in higher scores in self-management behaviors.
- Hypothesis 3: Higher scores in back pain-related knowledge will lead to higher scores in self-management behaviors.
- Hypothesis 4: Higher scores in active participation will result in higher scores in self-management behaviors.
- Hypothesis 5: Higher scores in internal health control will lead to higher scores in self- management behaviors.
- Hypothesis 6: Higher scores in self-efficacy will lead to higher scores in self- management behaviors.

2) Hypotheses with internal health control as the endogenous variable

- Hypothesis 7: Higher scores in negative disease perception will lead to lower scores in internal health control.
- Hypothesis 8: Higher scores in positive disease perception will result in higher scores in internal health control.
- Hypothesis 9: Higher scores in back pain-related knowledge will lead to higher scores in internal health control.
- Hypothesis 10: Higher scores in active participation will result in higher scores in internal health control.

3) Hypotheses with self-efficacy as the endogenous variable

- Hypothesis 11: Higher scores in negative disease perception will lead to lower scores in self-efficacy.
- Hypothesis 12: Higher scores in positive disease perception will result in higher scores in self-efficacy.
- Hypothesis 13: Higher scores in knowledge related to low back pain will lead to higher scores in self-efficacy.
- Hypothesis 14: Higher scores in active participation will result in higher scores in self-efficacy.

METHODS

1. Study Design

This study conducted structural modeling, aiming to construct a hypothetical model explaining self-management behaviors for chronic low back pain in patients with spinal disease and validate the model's fit and the research hypotheses presented in the model.

2. Participants

The study participants were patients with spinal disease who had experienced chronic low back pain for more than 3 months and were receiving outpatient treatment at the Neurosurgery and Spinal Center of G University Hospital in C City. The specific inclusion criteria for the study participants included a diagnosis of lumbar intervertebral disc herniation, spinal stenosis, or spondylolisthesis, aged 20 years or older, capable of communication, and willing to participate in the research after understanding its purpose and content. The exclusion criteria were individuals with pain related to conditions other than spinal disease, acute fractures, spinal tumors, inflammatory spinal diseases, congenital spinal deformities, a history of spinal surgery [15], and cognitive impairments or psychiatric disease. In order to calculate the number of research participants, we considered the sample size required for structural equation modeling. A sample size of 200 or more is recommended for structural equation modeling using the maximum likelihood estimation method [24]. Furthermore, as the sample size increases (typically between 400~500 participants), the sensitivity also increases, making it more likely to exceed the recommended fit indices. Therefore, for structural modeling analysis, a sample size of approximately 200~400 is generally preferred [25]. As a result, in this study, while meeting the minimum recommended level for measurement variables, we chose to select 240 participants for convenience, considering the ideal sample size of 200 and an attrition rate of 20%.

3. Study Tools

1) Self-management behaviors

Self-management behaviors for patients with chronic low back pain include daily postures, activities, exercises, and weight control [26]. These behaviors are performed to alleviate and prevent low back pain. An 18-item tool, with an additional 3 items related to medical facility utilization during severe low back pain episodes, was used to assess these behaviors [12]. This tool was based on a 15-item tool developed by Jung [26] specifically for patients with chronic low back pain. However, a confirmatory factor analysis to assess the tool's validity revealed that the factor loadings for item 5, "Avoid lying down for an extended period" (Cronbach's α=.27), item 10, "When the pain is severe, put a small pillow under the knees and lie down straight" (Cronbach's α=.39), item 11, "When the pain is severe, lie down in the same position for 1~2 days" (Cronbach's α=.24), and item 16, "When the pain is severe, take prescribed medication" (Cronbach's α=.38) were all below 0.4. This discrepancy is likely due to the difference in low back pain severity between the time of tool development (which was intended for inpatients requiring 2~3 days of bed rest due to severe low back pain) and the study participants, who were outpatients with moderate low back pain able to maintain their daily activities. Given this, items 10 and 16 were included in the self-management behavior items as their factor loadings were approximately 0.4 or lower, while items 5 and 11 were excluded. Consequently, 16 items were used in the final analysis. Each item is rated on a 4-point Likert scale from "almost never" (1) to "always" (4), with higher scores indicating a higher level of self-management behavior. The reliability of the tool in this study was Cronbach's α=.85.

2) Internal health locus of control

Internal health locus of control refers to an individual's inclination to believe that their health is determined by themselves [27]. In this study, internal health locus of control was measured using six items of the Multidimensional Health Locus of Control Scale (MHLC) Form A, which was developed by Wallston et al. [27] and translated into Korean by Kim and Lee [28]. Each item was measured on a 4-point Likert scale ranging from "not at all" (1) to "very much" (4). The scores ranged from a minimum of 6 to a maximum of 24, with higher scores indicating a higher level of internal health locus of control.

Cronbach's α, a measure of the tool's reliability, was .67~.77 at the time of its development, and Kim and Lee [28] reported a Cronbach's α of .77 for chronic pain patients. In this study, Cronbach's α was .82. Confirmatory factor analysis was conducted to validate the tool's reliability, and the factor loadings were all above 0.5.

3) Self-efficacy

Self-efficacy refers to an individual's confidence and belief that they can successfully perform the actions required to achieve desired outcomes [29]. In this study, the Pain Self Efficacy Questionnaire (PSEQ), developed by Nicholas [30] for chronic pain patients and translated into Korean by Yu and Lee [31], was used to measure this variable. The tool consists of a total of 10 items. Respondents indicate the degree to which they believe they could carry out everyday activities despite the pain in their lower back by marking a number from 0 (completely incapable) to 6 (completely capable) within the range on the left end of a line. The scores range from 0 to 60, with higher scores indicating higher pain self-efficacy. The reliability of the tool in Nicholas's study [30] tool was shown by a Cronbach's α of .92. In this study, Cronbach's α was .94. Confirmatory factor analysis was conducted to validate the tool's reliability, and the factor loadings were all above 0.5.

4) Disease perception

Disease perception refers to an individual's general, common-sense beliefs, expectations, understanding, and interpretations of disease symptoms [32]. This study measured disease perception using the Korean version of the Brief Illness Perception Questionnaire (Brief IPQ), which was developed by Broadbent et al. [33] and translated into Korean by Yoon [34]. The reliability of the tool at the time of development was confirmed for renal disease patients, with test-retest reliability shown by r values of 0.48~0.70. The tool's validity and reliability were also confirmed for patients with conditions such as asthma, diabetes, rheumatoid arthritis, chronic pain, acute pain, myocardial infarction, HIV, and multiple sclerosis. following aspects: item 1 pertains to consequences, item 2 to the timeline of the disease, item 3 to personal control, item 4 to treatment control, item 5 to the identity of symptoms from the disease, item 6 to illness concern, item 7 to coherence, and item 8 to emotional representation. Item 9, which is not included in the total score, is an open-ended question on causal factors, where individuals can record up to three causes in order of priority [34]. Broadbent et al. [33] argued that responses regarding disease causation cannot be quantified, but can be classified and analyzed in various ways depending on the research purpose and the specific disease being studied. Consequently, in this study, we excluded this item and used only the first 8 items. The measurement scale was a 10-point scale ranging from 0 to 10. Higher scores on items 1, 2, 5, 6, and 8 represent a more negative and threatening perception of the disease, while higher scores on items 3, 4, and 7 represent a more positive perception of the disease as the score increased. In this study, we measured 5 items (1, 2, 5, 6, and 8) as negative disease perception, and 3 items (3, 4, and 7) as positive disease perception. The reliability of the negative disease perception tool in this study was shown by a Cronbach's α of .84, while the positive disease perception tool' had a Cronbach's α of .56.

Confirmatory factor analysis was performed to evaluate the validity of the instruments used in this study. The findings showed that the factor loadings for negative disease perception were all greater than 0.5. In contrast, for positive disease perception, the factor loading for item 4 was .48. This value is close to the threshold of 0.5, and thus, item 4 was included as a key item.

5) Back pain-related knowledge

Back pain-related knowledge refers to understanding various aspects of back pain, including postures, behaviors that can cause back pain, and exercises or postures that can help prevent it [35]. In this study, a modified and enhanced version of the back pain-related knowledge tool developed by Kim et al. [11] was utilized. The back pain-related knowledge tool consists of 15 items, covering topics related to the causes, symptoms, and treatments of back pain, as well as postures and exercises in daily life. The content validity of the back pain-related knowledge tool was verified by an orthopedic spine specialist, a neurological spine specialist, and a professor of adult nursing. Respondents evaluate the content of each item as correct or incorrect. For each correct response, they receive 1 point, and for incorrect responses, they receive 0 points. Scores range from a minimum of 0 to a maximum of 15, with higher scores indicating higher levels of back pain-related knowledge. At the time of tool development, the reliability was shown by a Cronbach's α of .87. In this study, the Korean version of the tool exhibited a KR-20 value of .39 and a Cronbach's α of .62.

6) Active participation

Active participation refers to patients taking actions to provide necessary information for medical services and making efforts during the treatment process [36]. In this study, a tool for measuring patient participation, developed by Lee and Kim [36], was modified. This tool consists of 12 items, grouped into three subdomains: behavioral participation (6 items), emotional participation (3 items), and informational participation (3 items). Respondents use a 4-point Likert scale, with responses ranging from "not at all" (1) to "very much" (4) indicating the extent to which they participate in each aspect. Scores range from a minimum of 12 to a maximum of 48, with higher scores indicating greater levels of active participation. At the time of tool development, the reliability of the tool was demonstrated by a Cronbach's α of .89. In this study, the overall Cronbach's α was .91. The subdomain reliabilities were as follows: Cronbach's α=.84 for behavioral participation, Cronbach's α=.90 for emotional participation, and Cronbach's α=.71 for informational participation. Confirmatory factor analysis was conducted to confirm the tool's validity, and the factor loadings for all subdomains were above 0.5.

7) General characteristics, back pain, and disease-related characteristics

The researcher compiled a list of general and disease-related characteristics based on a literature review. The general characteristics encompassed factors such as age, gender, height, weight, education level, current living situation, occupation, work posture, and smoking status, amounting to eight items in total. Disease-related characteristics included the length of time since diagnosis, frequency of back pain episodes, severity of current back pain, duration of persistent back pain, extent of daily life disruption due to back pain, presence of sleep disturbances, history of depression, perceived causes of back pain, underlying conditions associated with back pain, radiating pain, medication usage, and current treatment methods, making up a total of 12 items. Data regarding the diagnosis, duration of the diagnosis, coexisting conditions, current treatment methods, hospitalization status, and surgical history were gathered from a review of electronic medical records.

4. Data Collection

Data collection for this study took place from January 21, 2021 to August 3, 2021, after receiving approval from G University Hospital's Institutional Review Board (IRB) and obtaining preliminary permission for data collection from the neurosurgery and spine center professors and nursing staff at the hospital. Data collection was carried out by one researcher and one research assistant. The research assistant underwent training via two preliminary meetings prior to the data collection. These meetings covered the research objectives, ethical considerations concerning the participants, and the methodology for data collection using the survey instrument. To ensure inter-rater reliability, the research assistant and the researcher conducted simultaneous interviews with the same participant to reconcile any discrepancies in assessment results. The researcher initially selected individuals who met the criteria from the neurosurgery and spine center outpatient clinic reservation list. The research assistants then explained the purpose, procedures, and other details of the research to the selected participants, both orally and in writing. The participants voluntarily signed informed consent forms and completed the questionnaire themselves. The surveys were conducted in the outpatient waiting room and took approximately 20 minutes to complete. The research team reviewed the questionnaires on-site to ensure there were no missing responses before collecting them. A total of 293 patients were approached for data collection. During the data collection process, some patients were found not to meet the selection criteria due to factors such as a surgical history. After excluding these cases, 240 questionnaires were collected. Out of these 240 questionnaires, 22 were excluded from the final analysis due to non-response to items on key variables in 13 cases and indications of dishonest responses, such as repeating the same answers, in 9 cases. Consequently, 218 questionnaires were used for the final analysis.

5. Ethical Considerations

To protect the rights of research participants, data collection for this study began after receiving notification of approval from G University Hospital's IRB on January 20, 2021 (IRB No: 2020-12-020-003). Participants were thoroughly informed about the study's objectives, privacy safeguards, and data management procedures. They were also fully briefed on their role in the study, which involved voluntarily completing a questionnaire and allowing the researcher to review their medical records. Written informed consent was obtained after participants were assured that their participation was entirely voluntary and could be discontinued at any time. Upon completing the questionnaire, participants received a hand sanitizing set, valued at 5,000 KRW, as a token of appreciation. The review of medical records took place after the questionnaires were completed. All data gathered from the questionnaires and medical records were managed in accordance with the Personal Information Protection Act. To maintain anonymity, each participant was assigned a unique code number. Before data collection began, a research assistant was trained on the research process, ethical considerations, and participant confidentiality. All collected data were securely stored in a locked facility within the researcher's private office and were disposed of once the research results were published.

6. Data Analysis

Data analysis was conducted using SPSS version 25.0 and AMOS 22.0. Frequency analysis and descriptive statistics were used to examine the general characteristics of the participants, their back pain and disease-related characteristics, and measurement variables. The normality of data distribution in the sample was evaluated using univariate normality tests in SPSS, and multivariate normality tests were conducted using the AMOS program. The mean, standard deviation, skewness, and kurtosis were examined. Multicollinearity was assessed among the measured variables using tolerance limits, variance inflation factors, and Pearson correlation coefficients. Confirmatory Factor Analysis (CFA) was used to evaluate the validity of latent variables in the context of structural equation modeling. Convergent validity was assessed based on factor loading, Average Variance Extracted (AVE), and construct reliability. The structural equation model's goodness of fit was evaluated using the maximum likelihood method. The indices used to assess the model fit included x^2/df, Root Mean-Square Residual (RMR), Root Mean Squared Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI). Bootstrapping was performed to evaluate the statistical significance of the direct, indirect, and total effects within the proposed model.

RESULTS

1. Participants' General Characteristics

The participants had a mean age of 53.89±14.27 years, with the largest age group being 60~69 years old (37.2%). This was followed by the group aged 49 or below (32.6%). Women constituted 56.0% of the sample, while men made up the remaining 44.0%. The mean Body Mass Index (BMI) of the participants was 24.15±3.50 kg/m². The most prevalent BMI category was underweight/normal weight (37.2%), followed by overweight (30.3%), mild obesity (25.7%), and severe obesity (6.9%). The most common occupational category was homemakers (33.0%), followed by office workers (21.1%). In terms of work posture, 39.0% primarily worked while seated, and 37.2% had jobs that required walking back and forth. Regarding back pain and disease-related characteristics, the average duration since disease diagnosis was 4.02±5.71 years, with the majority (42.2%) having been diagnosed within the past 1~5 years. The most common primary condition causing back pain was intervertebral disc herniation (56.0%), followed by spinal stenosis (40.4%) and spondylolisthesis (13.3%). The frequency of back pain was highest for daily occurrences (66.5%), followed by once every 2-3 days (17.0%), once a week (7.8%), and once a month (8.7%). The average severity of back pain was rated 5.87±1.94 on a 10-point scale, with the majority (33.5%) scoring between 4 and 6 points, and the next largest group (31.7%) scoring between 6 and 8 points (Table 1).

2. Correlation between Participants' Self-Management Behaviors and Influencing Factors

The correlations among the study participants' self-management behaviors, negative disease perception, positive disease perception, back pain-related knowledge, active participation, self-efficacy, and internal health locus of control are shown in Table 2. If the absolute value (r) of the correlation coefficient between measurement variables exceeds .90, there is a possibility of multicollinearity, meaning that one of the variables should be excluded [24]. However, in this study, the largest correlation coefficient was .76, indicating the absence of multicollinearity issues.

3. Normal Distribution and Multicollinearity of Key Variables

The score distribution of the measurement variables used in the hypothesis model was examined by calculating the mean and standard deviation. The descriptive statistics are displayed in Table 1. As part of the univariate normality assessment, which verifies the basic assumption of a normal distribution, the skewness and kurtosis of the main variables were analyzed. Skewness values that exceed an absolute value of 2 and kurtosis values that exceed an absolute value of 7 suggest problems with the assumption of normal distribution [37]. In this study, the skewness of the included measurement variables ranged from -0.28 to 0.47, and kurtosis ranged from -1.06 to 0.64. This confirms that all variables adhered to a univariate normal distribution.

Before we could validate the hypothetical model, we first evaluated the potential for multicollinearity among the variables used in the model. This was done through tolerance, the Variance Inflation Factor (VIF), and correlation analysis. The tolerance values ranged from 0.32 to

Table 1. General Characteristics of the Participants and Descriptive Statistics of Measured Variables (*N*=218)

Variables	Categories	n (%)	M±SD	Skewness	Kurtosis
Age (year)	≤49	71 (32.6)	53.89±14.27		
	50~59	51 (23.4)			
	60~69	81 (37.2)			
	≥70	15 (6.8)			
Gender	Men	96 (44.0)			
	Women	122 (56.0)			
Obesity(body mass index)	Low/normal weight	81 (37.1)	24.15±3.50		
	Overweight	66 (30.3)			
	Mild obesity	56 (25.7)			
	High obesity	15 (6.9)			
Education level	Below middle school	46 (21.1)			
	High school	79 (36.2)			
	Above college	93 (42.7)			
Current living situation	Living alone	37 (17.0)			
	Spouse	76 (34.8)			
	Spouse + children	70 (32.1)			
	Others	35 (16.1)			
Occupation	Agriculture/fishery	17 (7.8)			
	Office worker	46 (21.1)			
	Sales/service/production	40 (18.4)			
	Housewife	72 (33.0)			
	Others	22 (10.1)			
	Unemployed	21 (9.6)			
Work posture	Sitting on a chair	85 (39.0)			
	Squatting down	28 (12.8)			
	Standing still	21 (9.6)			
	Walking around	81 (37.2)			
	Others	3 (1.4)			
Smoking status	Yes	30 (13.8)			
	No	162 (74.3)			
	Past smoking	26 (11.9)			
Self-management behaviors			2.73±0.45	-0.08	-0.35
Internal health locus of control			3.14±0.38	0.35	0.64
Self-efficacy			3.46±1.03	0.25	-0.80
Negative disease perception			6.52±1.83	-0.27	-0.47
Positive disease perception			6.02±1.66	-0.30	-0.10
Back pain-related knowledge			0.70±0.12	-0.28	-0.41
Active participation	Behavioral participation		3.16±0.46	0.34	-0.30
	Emotional participation		3.35±0.47	0.30	-1.06
	Informational participation		3.29±0.47	0.29	-0.90

M=mean; SD=standard deviation.

0.99, all of which exceeded 0.1. The VIF values ranged from 1.01 to 3.13, all of which were below 10. These results indicate that there were no issues with multicollinearity (Table 1).

4. Verification of the Hypothetical Model and the Modified Model's Fit

Since the measurement variables in this study were presumed to be normally distributed, we conducted a test

Table 2. Pearson Correlation Coefficients for Measured Variables (*N*=218)

Variables		1	2	3	4			5	6	7
					4-1	4-2	4-3			
		r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)
1. Negative disease perception		1.00								
2. Positive disease perception		.13 (.047)								
3. Back pain-related knowledge		.02 (.728)	.01 (.859)							
4. Active participation	4-1. Behavioral participation	.21 (.001)	.04 (.538)							
	4-2. Emotional participation	.17 (.009)	.04 (.472)	.66 (<.001)						
	4-3. Informational participation	.16 (.013)	.03 (.598)	.71 (<.001)	.76 (<.001)					
5. Internal health locus of control		-.00 (.902)	.17 (.010)	-.03 (.660)	.45 (<.001)	.45 (<.001)	.50 (<.001)			
6. Self-efficacy		-.29 (<.001)	.27 (<.001)	-.00 (.916)	.12 (.070)	.10 (.136)	.06 (.368)	.29 (<.001)		
7. Self-management behaviors		-.15 (.027)	.24 (<.001)	.00 (.961)	.39 (<.001)	.17 (.008)	.25 (<.001)	.37 (<.001)	.32 (<.001)	1.00

of the hypothesis model's fit using maximum likelihood estimation. The results showed that the chi-square value (x^2=40.60, $p<.001$) was not suitable, and the normalized x^2 value was 3.12, marginally below the acceptable threshold. Absolute fit indices, such as RMR (.01) and GFI (.96), were within acceptable limits, but RMSEA (.09) did not quite reach the recommended level. Incremental fit indices, including NFI (.93) and CFI (.95), were acceptable, while TLI (.86) was slightly below the fit criterion.

The hypothesis model in this study did not achieve the recommended goodness of fit, prompting us to explore a modified model. One of the diagnostic indicators in AMOS, the Modification Index (MI), allows for covariance between measurement errors within the same variable. Therefore, when a high MI is present, it becomes feasible to sequentially allow for covariance between errors within the same variable [24]. In light of the theoretical rationale concerning the relationship between the internal health locus of control and self-efficacy [38-40], a high MI (MI=13.174) was observed in this study. We improved the model fit by sequentially allowing for covariance between the residual variables of the internal health locus of control and self-efficacy theory variables, which resulted in a better fit than the original hypothesis model.

Upon assessing the fit of the modified model, the chi-square value (x^2=26.96, $p<.001$) suggested a poor fit. However, the normalized χ^2 of 2.25 did meet the recommended level. Absolute fit indices, such as the RMR (.01), RMSEA (.07), and GFI (.97), all satisfied the recommended levels. Similarly, incremental fit indices, including the NFI (.95), TLI (.92), and CFI (.97), exhibited values compatible with recommendations.

5. Estimation of Path Coefficients in the Modified Model

In the estimation of model parameters for the modified hypothesis model, eight out of the 14 paths were significant, while six paths were not significant (Table 3).

Internal health locus of control significantly impacted active participation (β=.55, $p<.001$), accounting for 32.3% of the variance in this variable. Self-efficacy was significantly affected by both negative disease perception (β=-.34, $p<.001$) and positive disease perception (β=.30, $p<.001$), explaining 19.5% of the variance in self-efficacy. Self-management behaviors was significantly influenced by negative disease perception (β=-.15, p=.021), positive disease perception (β=.15, p=.016), active participation (β=.16, p=.037), internal health locus of control (β=.20, p=

.007), and self-efficacy (β=.15, p=.022). These factors accounted for 23.9% of the variance in self-management behaviors (Table 3).

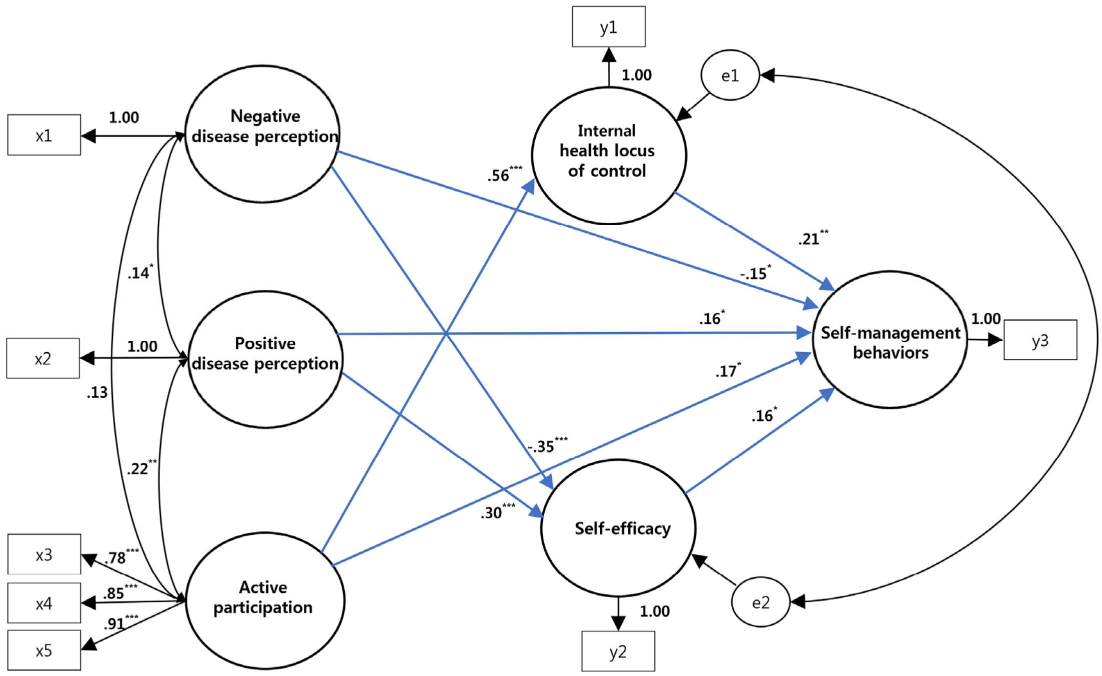
6. Analysis of the Effects in the Modified Model

In the modified hypothesis model of this study, we utilized bootstrapping to examine the direct, indirect, and total effects of exogenous variables on endogenous variables. The factors that significantly impacted self-management behaviors included negative disease perception (β=-.22, p=.021), positive disease perception (β=.21, p=.014), active participation (β=.29, p=.006), internal health locus of control (β=.20, p=.007), and self-efficacy (β=.15, p=.022). Negative disease perception exerted a direct negative influence on self-management behaviors (β=-.15, p=.021) and also demonstrated a significant total effect via self-efficacy (β=-.07, p=.007). Positive disease perception, on the other hand, had a direct positive impact on self-management behaviors (β=.15, p=.016) and also showed a significant total effect through self-efficacy (β=.06, p=.005). Active participation directly positively affected self-management behaviors (β=.16, p=.037) and also had a significant total effect through the internal health locus of control (β=.12, p=.005). The internal health locus of control had a direct positive effect on self-management behaviors, leading to a significant total effect. Similarly, self-efficacy had a direct positive impact on self-management behaviors, resulting in a significant total effect (Table 3, Figure 2).

Table 3. Direct, Indirect, and Total Effects of the Modified Model (*N*=218)

Endogenous variables	Exogenous variables	Standardized estimates	SE	CR	SMC	Direct effect	Indirect effect	Total effect
						β (p)	β (p)	β (p)
Internal health locus of control	Negative disease perception	-.10	.01	-1.84	.32	-.10 (.065)	-	-.10 (.065)
	Positive disease perception	.07	.01	1.20		.07 (.229)	-	.07 (.229)
	Back pain-related knowledge	-.05	.17	-0.95		-.05 (.340)	-	-.05 (.340)
	Active participation	.55	.07	8.07		.55 (<.001)	-	.55 (<.001)
Self-efficacy	Negative disease perception	-.34	.03	-5.60	.19	-.34 (<.001)	-	-.34 (<.001)
	Positive disease perception	.30	.03	4.80		.30 (<.001)	-	.30 (<.001)
	Back pain-related knowledge	-.00	.50	-0.11		-.00 (.909)	-	-.00 (.909)
	Active participation	.09	.18	1.39		.09 (.163)	-	.09 (.163)
Self-management behaviors	Negative disease perception	-.15	.01	-2.31	.23	-.15 (.021)	-.07 (.007)	-.22 (.021)
	Positive disease perception	.15	.01	2.41		.15 (.016)	.06 (.005)	.21 (.014)
	Back pain-related knowledge	.00	.21	0.07		.00 (.942)	-.01 (.274)	-.00 (.868)
	Active participation	.16	.10	2.08		.16 (.037)	.12 (.005)	.29 (.006)
	Internal health locus of control	.20	.09	2.67		.20 (.007)	-	.20 (.007)
	Self-efficacy	.15	.03	2.29		.15 (.022)	-	.15 (.022)

SE=standard error; CR=critical ratio; SMC=squared multiple correlations.



*$p<.05$, **$p<.01$, ***$p<.001$.

x1: Negative disease perception; x2: Positive disease perception; x3: Behavioral participation; x4: Emotional participation; x5: Informational participation; y1: Internal health locus of control; y2: Self-efficacy; y3: Self-management behaviors.

Figure 2. Final model of this study.

DISCUSSION

In this study, the mean score for self-management behaviors was 2.73 out of 4 among patients with spinal disease. This score translates to 68.2 on a 100-point scale, indicating a relatively low level of self-management. This score is higher than the score of 2.36 reported in Jung's study [12], which focused on elderly patients receiving outpatient treatment in a general hospital using the same measurement tool. Our score also surpassed the 3.73 out of 6 points reported in a study by Prompuk et al. [15], which used different tools and focused on adult patients with chronic back pain. Additionally, it exceeded the 2.65 out of 4 points reported in Kawi's study [16], which involved patients with chronic back pain receiving outpatient treatment in primary care clinics and specialized pain centers. Although the level of self-management behaviors for chronic pain showed some variations depending on the study participants, it was generally not very high. This finding suggests the need for future comparative analyses involving a more diverse range of participants using the same measurement tool.

The model testing results of this study revealed that self-management behavior in patients with spinal disease was directly influenced by several factors: negative disease perception, positive disease perception, active participation, internal health locus of control, and self-efficacy. It was found that negative disease perception had a direct, negative impact on self-management behaviors. This suggests that higher levels of negative disease perception, characterized by a threatening and negative view of the illness, are linked with lower self-management behaviors. In simpler terms, the more negative and threatening the illness is perceived, the less likely the patient is to engage in self-management behaviors. These findings are consistent with previous research. For instance, Lee [18] found a negative correlation between disease perception and self-care behaviors in individuals with a more negative perception of their illness, a finding that aligns with this study. Goodman et al. [19] also reported similar results, noting that individuals who express negative emotions towards their illness or perceive it as more severe tend to engage less in self-management behaviors. Furthermore, in patients with chronic low back pain, those who perceived the duration of their chronic illness and the severity of their symptoms more negatively continued to experience higher levels of disability due to pain after six months. These patients were more likely to exhibit inactivity, passivity, treatment non-adherence, and avoidance behavior, as Foster's study [41] found. Conversely, positive illness perception was found to have a direct, positive impact on self-management behaviors. This implies that individuals who perceive their illness more positively are more likely to engage in self-management behaviors. This aligns with the findings of Yoon's study [34], which found a significant positive correlation between positive disease perception and self-care behaviors. Additionally, Sung and Lee's study [42] found that illness perception was a factor influencing self-care behaviors. Their analysis by subdomain of disease perception revealed that higher scores on items related to positive disease perception were associated with better self-care behaviors.

This study found that patients' perception of their disease, whether negative or positive, significantly influenced their self-management behaviors. Specifically, individuals who perceived their disease negatively tended to engage less in self-management behaviors, while those with a more positive perception were more likely to engage extensively in self-management. This indicates that a positive disease perception enhances the belief in the effectiveness of treatment, thereby promoting faster recovery [43]. Conversely, a negative disease perception can slow recovery, irrespective of the disease's severity [44]. Furthermore, a meta-analysis by Hagger and Koch [20] on factors influencing disease perception demonstrated that individuals who experienced more disease symptoms and believed the disease had a substantial impact were more likely to adopt avoidance or negative coping strategies. Conversely, those who believed they could control their disease tended to employ problem-solving-oriented coping strategies. Those findings are consistent with the results of this study.

Therefore, even among patients with the same disease, self-management behaviors can vary based on their individual perceptions of the disease. Consequently, it is important to first determine whether a patient's perception of their disease is positive or negative. Healthcare professionals play a pivotal role in this process, as they can encourage patients with spinal disease to gain an accurate understanding of their condition and maintain a positive attitude. This, in turn, can empower these patients to manage their chronic pain more effectively.

Active participation was identified as a direct factor influencing self-management behaviors in patients with spinal disease. It also indirectly influenced these behaviors through the internal health locus of control. This finding is consistent with the study by Ishikawa and Yano [21], which reported that patient participation boosted self-efficacy and enhanced self-management abilities. Tobey et al. [45] found that individuals who responded positively and actively to pain were more effective in managing stress related to pain, thereby maintaining their abilities more effectively. Patients with chronic diseases are often required to make a variety of decisions to manage their symptoms, seek out health information, and communicate with healthcare professionals as part of their active involvement in health management. This active participation has been demonstrated to positively affect health outcomes [46]. Encouraging patients to take an active role in their treatment process can improve their self-efficacy and health management abilities, leading to better self-management behaviors. Therefore, healthcare professionals should assist patients in understanding their responsibility for managing their health, provide information about back pain, offer ongoing support, and promote patient communication. This approach can help to foster patients' active involvement in health management and, consequently, enhance self-management behaviors for chronic pain in patients with spinal disease.

Internal health locus of control was identified as a factor directly influencing self-management behaviors in patients with spinal disease. These results align with the study conducted by Lee and Lee [23], which discovered a positive correlation between the internal health locus of control and health behaviors among participants in Laos. Their study demonstrated that a higher internal health locus of control positively influenced health behaviors. Similarly, Shin and Kang's research [22] on patients with coronary artery disease revealed that internal health locus of control was a significant variable affecting health behaviors. Therefore, to improve self-management behavior in patients with spinal disease, it is necessary to develop intervention strategies aimed at improving the internal health locus of control.

In this study, self-efficacy was identified as a direct factor influencing self-management behaviors. This finding aligns with the study by Park and Shin [4], which reported a significant correlation between self-efficacy and health behaviors among elderly women suffering from chronic low back pain. Their research indicated that an increase in self-efficacy resulted in more health-promoting behaviors. Similarly, the study of Prompuk et al. [15] on self-management causal models for adult patients with chronic low back pain determined that self-efficacy directly influenced self-management, a conclusion that mirrors the results of this study. Hutting et al. [17], in a study on self-management strategies for patients with musculoskeletal diseases, also recognized self-efficacy as a crucial determinant in self-management. Therefore, interventions designed to boost pain self-efficacy in patients with spinal disease should be introduced to improve chronic pain self-management behaviors.

Lastly, among the exogenous variables in this study, back pain-related knowledge was found to have no significant correlation with self-management behaviors. This finding contradicts Jung's study [12], which suggested that knowledge about pain influences self-management behaviors in patients suffering from chronic low back pain. It also diverges from the study of Prompuk et al. [15], which identified knowledge about low back pain as a direct factor influencing self-management in adults experiencing chronic pain. Despite the lack of a significant correlation between pain-related knowledge and self-management behaviors in the current study, it is crucial to acknowledge that knowledge, as a cognitive factor, has its limitations in altering and maintaining behavior. Knowledge can, however, boost individual motivation by transforming personal beliefs and attitudes towards health behaviors [47]. Therefore, additional research is necessary to further investigate the correlation between back pain-related knowledge and self-management behaviors.

Using empirical data, this study validated the fit of the model and the significance of the hypothesized and direct and indirect paths. However, the fit of the hypothetical model was slightly below the recommended level, indicating a need for model modification. To rectify this, we used the modification index to link the structural errors between internal health locus of control and self-efficacy, resulting in a revised model. This modified model met the recommended fit level. Of the 14 paths analyzed, eight were significant, while six were not.

In this structural model, negative disease perception, positive disease perception, active participation, internal health locus of control, and self-efficacy collectively accounted for 23.9% of chronic pain self-management behaviors in patients with spinal disease. This percentage is lower than the 33% reported by Prompuk et al. [15] for self-management behaviors among adult patients with chronic low back pain. Their study considered factors such as back pain-related knowledge, social support, self-efficacy, and beliefs about treatment efficacy. The discrepancy may be due to our initial inclusion of knowledge related to low back pain in the hypothetical model, which did not show a significant correlation with self-management behaviors during model validation and was therefore excluded from the final model. Consequently, future research should consider other potential factors that may influence chronic low back pain self-management behaviors.

The adequacy of the proposed model did not meet the recommended level, prompting the presentation of a revised model. This model connects the residual variables of the internal health locus of control and self-efficacy theory variables, using the MI. This connection is made under the assumption that there could be a logical basis for the covariance's existence. It's crucial to remember that model modifications, if based solely on statistical significance, can become illogical, even if statistically confirmed. The study of Rosenstock et al. [48], which outlined the relationship between health locus of control and self-efficacy, suggested that both internal health locus of control and self-efficacy are necessary for certain behaviors to occur. Furthermore, several previous studies [38-40] have demonstrated a correlation between internal health locus of control and self-efficacy. In this study, we introduced a modified model that connected the residual variables of internal health locus of control theory and self-efficacy theory, using the MI. The decision to connect the residual variables of these two theoretical variables was made based on prior research on the relationship between internal health locus of control and self-efficacy. Future research should further investigate these residual variables.

In summary, considering the results, this model is suitable for predicting and explaining the self-management behaviors of chronic low back pain in patients with spinal disease. The variables used in this study are expected to serve as foundational data for interventions aimed at improving the self-management of chronic low back pain in patients with spinal disease.

CONCLUSION

This study aimed to identify the factors that influence the self-management behavior of patients with spinal disease who are experiencing chronic low back pain, and to elucidate the causal relationships between these factors. Drawing on prior research and a comprehensive literature review, a hypothesis model was developed and subsequently validated. The variables that significantly impacted the self-management behaviors of patients suffering from chronic low back pain due to spinal disease included negative disease perception, positive disease perception, active participation, internal health locus of control, and self-efficacy. Notably, negative disease perception directly negatively affected self-management behaviors, while positive disease perception directly positively affected it. Furthermore, both negative and positive disease perceptions indirectly influenced self-management behaviors via self-efficacy. Active participation directly impacted self-management behaviors and also indirectly influenced it through the internal health locus of control.

Therefore, to improve the self-management behaviors of patients with spinal disease who are experiencing chronic pain, it is crucial to initially determine whether these patients have a positive or negative perception of their condition. Persistent encouragement from healthcare professionals is required to ensure that patients accurately understand their condition and maintain a positive mindset during self-management. Furthermore, in order to maintain the self-management behavior of patients with spinal disease, healthcare professionals should promote active patient involvement and devise nursing interventions that enhance the internal health locus of control and self-efficacy.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and design acquisition - JJS and KGS; Data collection - JJS; Analysis and interpretation of the data - JJS and KGS; Drafting and critical revision of the manuscript - JJS and KGS.

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