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Factors Associated with Subjective Health Status among People with Spinal Cord Injury: An Application of the International Classification of Functioning, Disability and Health Model

Haesun Lee[1], **Hye Jin Nam**[2], **Ju Young Yoon**[3]

[1]Graduate Student, College of Nursing, Seoul National University, Seoul, Korea
[2]Post-doctoral Researcher, College of Nursing, Seoul National University, Seoul, Korea
[3]Professor, College of Nursing, Seoul National University · Research Institute of Nursing Science · Center for Human-Caring Nurse Leaders for the Future by Brain Korea 21 (BK 21) Four Project, Seoul National University, Seoul, Korea

Purpose: This study aimed to identify factors influencing subjective health status among individuals with spinal cord injury (SCI) using the International Classification of Functioning, Disability and Health (ICF) model.
Methods: This study analyzed secondary data from the 2021 Survey on the Status and Needs of Individuals with SCI conducted by the Korea Spinal Cord Injury Association. A hierarchical multiple regression analysis was conducted in four steps. Independent variables included sociodemographic factors, satisfaction with medical services (environmental factor), the need for weight control, the need for nutritional education, the need for dietary management, and disability acceptance (personal factors) along with exercise and activity of daily living (activity and participation factors). These factors were added sequentially at each step based on the ICF model.
Results: A total of 513 participants were analyzed in this study, with an average subjective health status of 5.51±2.39. Higher satisfaction with medical services (β=.27, p<.001), frequent exercise (β=.19, p=.008), and a greater level of activities of daily living (β=.02, p<.001) were significantly associated with improved subjective health status. Conversely, a lower need for nutritional education (β=-.25, p=.042) was negatively associated.
Conclusion: This study highlighted satisfaction with medical services, nutrition education needs, exercise frequency, and activities of daily living as important factors. These findings provide insight into how the health status of individuals with SCI can be enhanced through targeted interventions and support from healthcare providers.

Keywords: Spinal cord injuries; Persons with disabilities; Health promotion

Introduction

Spinal cord injury (SCI) has a profound, multidimensional impact on an individual's life, leading to overwhelming changes. Since traumatic accidents are the leading cause of SCI, individuals often face physical, psychological, and social challenges as a result of this life-changing event [1]. Those with SCI may experience a wide range of health issues, including impairments in bowel and bladder function, mobility, and autonomic functions, as well as secondary conditions such as pressure ulcers and pain. These physical health problems can significantly affect activities of daily living and social participation, ultimately influencing on quality of life (QoL) [2]. Furthermore, individuals with SCI who adopt a passive attitude towards these challenges tend to experience lower life satisfaction, reduced autonomy, and negative perceptions of their abilities, which in turn limits their opportunities for positively coping with their injury [3]. A negative perspective of their health status can also increase the risk of suicide among

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Corresponding author: Ju Young Yoon
College of Nursing and Research Institute of Nursing Science, Seoul National University, 103 Daehak-ro, Jongno-gu, Seoul 03080, Korea
Tel: +82-2-740-8817 Fax: +82-2-741-5244 E-mail: yoon26@snu.ac.kr

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individuals with spinal cord injuries [4].

Understanding the impact of SCI on various aspects of health is crucial, particularly when considering subjective health status. Subjective health status is typically assessed through a single-item question that reflects how individuals perceive their overall health. Often referred to as self-assessed health, it is widely recognized for its simplicity and strong reliability in predicting mortality and future health outcomes, such as healthcare utilization [5]. This self-assessment is influenced by how individuals define health and health components in their life. Additionally, subjective health status reflects the social and contextual background of these health components (e.g., education, standard of living, social network), making it a valuable tool for identifying social determinants of health [5]. Therefore, subjective health status serves as a comprehensive approach to understanding the complex aspects of an individual's health, especially for those with SCI experiencing diverse changes and health-related challenges thorough their life.

Individuals with SCI often report lower subjective health status compared to the general population due to a combination of physical, psychological, and environmental factors [6,7]. SCI typically leads to significant physical disabilities, such as mobility impairments and respiratory complications, which directly impact an individual's ability to perform activities of daily living and maintain independence. Furthermore, individuals with SCI often experience mental health challenges such as depression and anxiety, which can further lower their perception of health and quality of life [8]. Given its importance, previous studies have identified that physical ability, self-efficacy, and psychological well-being influence the subjective health status of individuals with SCI [9,10]. Beyond individual factors, environmental conditions also play a crucial role in shaping the subjective health status of individuals with SCI. Access to appropriate healthcare services, the availability of assistive devices, and the accessibility of living spaces significantly influence their ability to manage daily activities and maintain autonomy [11]. Therefore, improving subjective health status in individuals with SCI requires a holistic approach that not only addresses physical and mental health but also considers the broader environmental context in which individuals live, as outlined in the International Classification of Functioning, Disability and Health (ICF) model.

The ICF model, developed by the World Health Organization (WHO), provides a comprehensive framework for understanding health and disability from a biopsychosocial perspective [12]. Unlike traditional models that focus solely on disease or dysfunction, the ICF model emphasizes the importance of both medical and societal factors in shaping an individual's overall health. This standardized framework encompasses five domains: body functions and structures, activities of daily living, social participation, personal characteristics, and environmental influences [12]. The ICF model comprises 1,495 categories across these components, highlighting the complex interactions between various factors. By providing universal language for multidisciplinary health providers, it has proven to be a useful conceptual framework for understanding the experience of health of individuals and populations. Previous study identified health problem and health-related factors in the early post-acute and the long-term contexts using ICF model, as evidenced by a worldwide expert survey [13]. Furthermore et al. [14] conducted systematic review of 116 articles on the development of a core-sets, which is list of selected categories from ICF numerical codes specific spinal cord injury. However, to the best of our knowledge, no research has specifically focused on the subjective health status of individuals with SCI and the factors influencing it in a comprehensive approach based on ICF model.

Building on prior studies, this study aims to explore the factors influencing subjective health status among individuals with SCI, using the ICF model. It is crucial for healthcare providers to understand the multidimensional aspects of health as perceived by individuals with SCI, so they can offer personalized treatment and education to support optimal health status and long-term health outcomes.

Methods

Study design

This cross-sectional, correlational study analyzed secondary data from the 'Survey on the Status and Needs of Individuals with Spinal Cord Injuries' conducted by the Korea Spinal Cord Injury Association (KSCIA). The KSCIA administers this survey every three years to gather descriptive statistics on individuals with SCI. Trained interviewers conducted face-to-face interviews through home visits from May to June 2021.

Participants/Samples

This study used data from the 2021 Survey on the Status and Needs of Individuals with SCI conducted by the KSCIA. Prior to conducting the research, the researchers obtained approval from KSCIA for data usage and received a formal data utilization agreement. The survey was administered to 600 registered members of KSCIA. Samples were limited to those who responded to all questionnaire items related to the variable in this study. The

variables include gender, age, marital status, level of education, monthly income, severity of disability, injured spinal region, satisfaction with medical services, need for nutritional education, need for dietary management, disability acceptance, frequency of exercising, activity of daily living, subjective health status. The final sample size was 513.

Variables

Figure 1 illustrates the conceptual framework of this study based on the ICF model. According to the ICF practical manual published by WHO, the variables in this research were categorized into the following domains: (a) disability severity and injured spinal region as demographic information in body functions and structures, (b) satisfaction with medical services as an environmental factors, (c) need for weight control, need for nutritional education, need for dietary management, disability acceptance as personal factors, (d) frequency of exercise in the activity domain, (e) activity of daily living in participation domain, and (f) subjective health status as a health condition [12].

1. General characteristics

This study collected demographic data, including gender, age, marital status, level of education, monthly income, severity of disability, and injured spinal region. Marital status was categorized into three groups: never married, married, and others, which included separated, divorced, and widowed individuals. Monthly income was calculated based on equalized income, defined as total household income divided by the square root of the number of household members. Finally, the severity of disability refers to the classification used for disability enrollment in the welfare system in South Korea and is divided into two categories: mild and severe.

2. Environmental factors

Personal satisfaction has gained increasing attentions as a key standard for evaluating the effectiveness of health care services delivery [15]. In particular, people with SCI have reported dissatisfaction with medical services due to the limited accessibility of healthcare facilities and the shortage healthcare providers specialized in SCI in primary care clinics [16]. Based on this background, this study selected satisfaction with medical services as environmental factors within the ICF model. Satisfaction with medical services was measured using a single question: "How satisfied are you with your current medical services?". Respondents rated their satisfaction on a scale from 0 to 10, where 0 represents 'strongly dissatisfied' and 10 represents 'strongly satisfied.' Higher scores indicate more positive perceptions of medical services.

3. Personal factors

The need for weight control, the need for nutritional education, the need for dietary management, and disability acceptance were selected as personal factors within the ICF model. The first three needs were measured using single-item questions: "Do you feel a need for weight control?", "Do you feel a need for nutritional guidance after spinal cord injury?" and "Do you feel a need for dietary management after spinal cord injury?". Participants rated their needs on a scale from 1 to 5, where 1 represents 'strongly

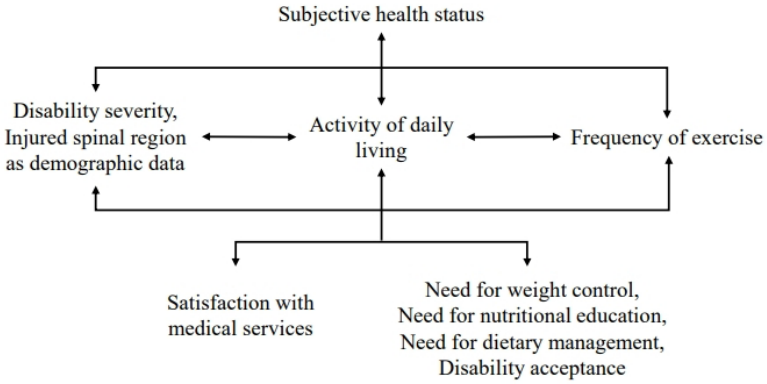


Figure 1. Conceptual framework of this study adopted from the ICF model
The ICF model is structed with five components: body functions and structures, activities of daily living, social participation, personal characteristics, and environmental influences. Variables included in this study organized within each component according to the ICF model.

disagree' and 5 represents 'strongly agree.' Higher scores indicate a greater need for weigh control, nutritional education and dietary management, respectively. KSCIA measured disability acceptance using the Disability Acceptance Scale (DAS) developed by Kaiser et al. [17]. The scale consists of nine items rated on a 5-point Likert scale. A sample item from DAS is: "I feel satisfied with my abilities, and my disability doesn't bother me too much". Scores range from 9 to 45, with higher scores indicating greater acceptance of one's disability. The reliability of the original measurement could not be identified, while the Cronbach's α of the measurement in this study was .45.

4. Activity and participation factors

The frequency of exercising and activity of daily living were selected as activity and participation factors within the ICF model. In the ICF model, activity refers to an individual's execution of a specific task or action, while participation encompasses not only social relationships, such as interpersonal interactions, but also engagement in various life situations. Given the conceptual overlap between activity and participation, the ICF model sometimes groups them together under the activity and participation domain. In this study, exercise frequency was examined as a form of regularly performed sports activity. Rather than a specific task, it was analyzed as participation, reflecting a proactive effort to maintain health in daily life. For the frequency of exercising, participants were first asked: "Do you exercise regularly to manage your health?". If participants answered "yes", they were asked a follow-up question: "How often do you exercise?". Responses were recoded for statistical analysis as follow. Those who answered "no" to the initial question were coded as "none = 1", while those who answered "yes" were coded based on their reported frequency: "10 times or less per year = 2", "1-3 times per month = 3", "1-3 times per week = 4", and "almost every day = 5". Higher scores indicated greater frequency of exercising. For activity of daily living, KSCIA employed modified measure to account for the functional status of individual of SCI [18]. The measurement consisted of 11 items assessing the degree of difficulty in performing daily activity. Activity of daily living included eating and drinking, washing the upper and lower body, dressing the upper and lower body, grooming, bladder management, bowel management, toileting, short-distance transfers (e.g., bed to wheel chair) and long-distance transfers. Respondents rated their difficulty on a scale from 0 to 10, with 0 representing "no difficulty" and 10 representing "severe difficulty". Higher scores indicated greater difficulty in performing activity of daily living.

5. Subjective health status

As a dependent variable, subjective health status was assessed using a single question: "How would you rate your overall health, excluding your spinal cord injury?". Respondents rated their subjective health on a scale from 0 to 10, where 0 represented "not healthy at all" and 10 represented "very healthy". Higher scores indicated a better perception of one's health.

Ethical consideration

This study received an exemption determination from the Institutional Review Board of Seoul National University (IRB No. 2405/002-001). The researcher obtained approval to access the raw data, questionnaire, and codebook provided by the Korea Spinal Cord Injury Association. To ensure the confidentiality of personal information, the data provided was anonymized using unique numbers to make personal data unidentifiable.

Data analysis

Data were analyzed using IBM Statistical Package for Social Sciences (SPSS, version 22.0; IBM Corporation, Armonk, NY: USA). Prior to analysis, the data were examined to detect any outliers, and the distribution was assessed for normality to ensure that the assumptions of basic statistical tests were met. Descriptive statistics, including means, standard deviations(SD), and percentages, were used to summarize the demographic characteristics of the participants. Pearson correlation was used to assess the relationships among the variables before conducting hierarchical multiple regression analysis. The hierarchical multiple regression models were structured with subjective health status as the dependent variable and environmental, personal, activity and participation factors based on the ICF model as the independent variables. The ICF model emphasizes the interactions among domains surrounding health problems, making it challenging to express causal relationships. However, recent studies have used the ICF model to examine causal relationships among socio-demographic factors, health problems, activity, and participation, as well as how the degree of these relationships' changes depending on environmental factors [19]. Before designing the hierarchical multiple regression models, researchers identified the relationship between factors as follows. Individuals with more severe SCIs, such as tetraplegia or complete lesions, tend to experience greater health complications and have higher healthcare needs, leading to increased hospital utilization. However, their satisfaction with healthcare services remains low due to limited access to specialized treatment [20]. Conversely, when individuals with SCIs receive integrated specialized care from

healthcare providers who understand their condition, they report higher satisfaction, which fosters trust and long-term relationships between patients and medical professionals [21]. These environmental factors act as facilitators, encouraging individuals with SCIs to accept their disability and to actively engage in self-management, including weight control, nutritional education and dietary management [22]. Ultimately, this process lays the foundation for improved health behaviors and greater participation in daily activities [21]. Based on these prior studies, a four-step approach was conducted as follows. In the first regression model, sociodemographic factors were entered as independent variables. In the second regression model, satisfaction with medical services was included as additional independent variables. The third regression model added the need for weight control, the need for nutritional education, the need for dietary management and disability acceptance. Finally, in the fourth model, frequency of exercising and activity of daily living were included as additional independent variables.

Results

General characteristics of participants

The general characteristics of the study participants are described in Table 1. Participants were predominantly male (70.8%). The average age was 52.22 ± 11.56, and 31.2% were in 60s. The majority were married (43.7%) and had completed secondary education or higher (51.5% and 42.7%, respectively). In terms of monthly income, 41.7% earned less than or equal to 1,000,000 KRW, followed by 32.4% who earned between 1,000,000 KRW and 2,000,000 KRW. Nearly all participants (98.4%) were classified as having severe disabilities. The primary injury regions were the thoracic spine (50.5%) and the cervical spine (41.7%).

Correlations among main variables

Table 2 presents the Pearson's bivariate correlations between variables. The results showed that higher satisfaction with medical services was significantly correlated with better subjective health status (r = .33, p < .001), improved activity of daily living (r = .15, p = .001), greater disability acceptance (r = .12, p = .006), and higher frequency of exercising (r = .10, p = .030). Additionally, it showed a significant negative correlation with need for nutritional education (r = -.18, p < .001), need for dietary management (r = -.15, p = .001) and need for weight control (r = -.11, p = .014). A higher need for weight control was significantly correlation with a higher need for dietary management (r = .55, p < .001) and the need for nutritional education (r = .36, p < .001). Conversely, a higher need for weight control was significantly correlated with poorer subjective health status (r = -.15, p = .001). A higher need for nutritional education was significantly correlated with a higher need for dietary management (r = .65, p < .001) but correlated with poorer subjective health status (r = -.22, p < .001) and lower activity of daily living (r = -.11, p = .011). More Frequency of exercising was significantly correlated with improved subjective health status (r = .18, p < .001). Finally, improved activity of daily living was significantly correlated with greater subjective health status (r = .30, p < .001).

Hierarchical multiple regression analysis of variables on subjective health status

Table 3 showed the results of the hierarchical multiple regression analysis. The regression model was statistically significant in all four steps: model 1 (F = 3.84, p < .001), model 2 (F = 8.33, p < .001), model 3 (F = 7.59, p < .001), and model 4 (F = 9.04, p < .001). The explanatory power of the model, based on the adjusted R^2, increased from 7% in model 1 to 17% in model 2, 19% in model 3, and 24% in model 4. The Durbin-Watson statistic was 1.874, which is close to 2, indicating that the assumption of independence of residuals was likely satisfied. The variance inflation factor (VIF) values were all below 10, suggesting that multicollinearity was not a concern. In the final model, gender and age were significantly positively associated with subjective health status among the control variables. Males (β = .11, p = .007) showed a stronger associated with subjective health status compared to female, while younger adults (β = .12, p = .032) and middle-aged adults (β = .11, p = .040) had higher subjective health status than older adults. Regarding monthly income, the lowest income group was significantly associated with poorer subjective health status (β = -.23, p = .004) Greater satisfaction with medical services (β = .26, p < .001), higher frequency of exercise (β = .11, p = .008), and better activities of daily living (β = .24, p < .001) were significantly associated with improved subjective health status. Conversely, lower need for nutritional education significantly related to poorer subjective health status (β = -.11, p = .042).

Discussion

This study aimed to explore the factors that affect subjective health status among individuals with SCI in South Korea, utilizing the ICF conceptual framework. A total of fourteen variables, including demographic characteristics, were analyzed. The findings indicated that greater satisfaction with medical services (environmental factors), reduced need for nutrition education (per-

Table 1. Characteristics of participants (*N*=513)

Categories	Variables	Categories	n (%) or Mean ± SD
Demographic information	Gender	Male	363 (70.8)
		Female	150 (29.2)
	Age		52.22 ± 11.56
		21~39	60 (11.7)
		40~64	363 (70.8)
		≥ 65	90 (17.5)
	Marital status	Never married	190 (37.0)
		Married	224 (43.7)
		Others†	99 (19.3)
	Level of education	≤ Primary education	30 (5.8)
		Completed secondary education	264 (51.5)
		Completed tertiary education	219 (42.7)
	Monthly income‡ (Unit: KRW)	≤ 1,000,000	214 (41.7)
		1,000,001 ~ 2,000,000	166 (32.4)
		2,000,001 ~ 3,000,000	90 (17.5)
		≥ 3,000,001	43 (8.4)
Body functions and structures	Disability severity	Mild	8 (1.6)
		Severe	505 (98.4)
	Injured spinal region	Cervical	225 (41.7)
		Thoracic	259 (50.5)
		Lumbar	29 (5.7)
Environmental factors	Satisfaction with medical services		5.09 ± 2.30
Personal factors	Need for weight control		3.85 ± 1.16
	Need for nutritional education		3.72 ± 1.03
	Need for dietary management		3.85 ± 1.03
	Disability acceptance		29.50 ± 3.97
Activity	Frequency of exercising§		3.61 ± 1.39
Participation	Activity of daily living		40.73 ± 27.88
Health condition	Subjective health status		5.51 ± 2.39

†Others includes "separated", "divorced", and "Widowed"; ‡Monthly income was calculated based on equivalized income (i.e., total household income divided by the square root of the number of household members); §Respondents reporting "None", "10 times within a year", "1~3 times per month", "1~3 times per week", "almost every day".

Table 2. Correlations among main variables (*N*=513)

Variables	X1	X2	X3	X4	X5	X6	X7	X8
	Person's correlation coefficient, r (*p*)							
Satisfaction with medical services	1							
Need for weight control	-.11 (.014)	1						
Need for nutritional education	-.18 (< .001)	.36 (< .001)	1					
Need for dietary management	-.15 (.001)	.55 (< .001)	.65 (< .001)	1				
Disability acceptance	.12 (.006)	.04 (.418)	.06 (.178)	.11 (.013)	1			
Frequency of exercising	.10 (.030)	-.01 (.944)	-.03 (.550)	.05 (.300)	-.01 (.889)	1		
Activity of daily living	.15 (.001)	-.06 (.211)	-.11 (.011)	-.12 (.005)	-.01 (.005)	.07 (.117)	1	
Subjective health status	.33 (< .001)	-.15 (.001)	-.22 (< .001)	-.16 (< .001)	.05 (.284)	.18 (< .001)	.30 (< .001)	1

X1=satisfaction with medical services; X2= need for weigh control; X3=need for nutritional education; X4=need for dietary management; X5=disability acceptance; X6-=frequency of exercising; X7=activity of daily living; X8=subjective health status.

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Table 3. Hierarchical regression analysis of variables on subjective health status (*N*=513)

Independent variables		Model 1				Model 2				Model 3				Model 4			
		B	β	t	*p*	B	β	t	*p*	B	β	t	*p*	B	β	t	*p*
(Constant)		5.29		5.23	< .001	3.16		3.18	.002	4.98		3.76	< .001	2.53		1.87	.062
A	Gender (ref: Female)																
	Male	0.61	.12	2.61	.009	0.61	.12	2.76	.006	0.56	.11	2.56	.011	0.58	.11	2.70	.007
	Age (ref: ≥ 65)																
	19 ~ 39	0.94	.13	2.08	.038	1.13	.15	2.65	.008	1.19	.16	2.80	.005	0.89	.12	2.15	.032
	40 ~ 64	0.69	.13	2.27	.024	0.67	.13	2.34	.020	0.67	.13	2.37	.018	0.57	.11	2.06	.040
	Marital status (ref: Others)																
	Never married	0.40	.08	1.29	.198	0.26	.05	0.89	.376	0.11	.02	0.37	.715	0.11	.02	0.39	.699
	Married	0.35	.07	1.18	.240	0.31	.06	1.11	.268	0.29	.06	1.05	.293	0.26	.06	1.00	.323
	Level of education (ref: Tertiary education)																
	≤ Primary education	1.25	.12	2.55	.011	1.08	.11	2.33	.020	0.92	.09	2.01	.045	0.80	.08	1.79	.074
	Secondary education	0.58	.12	2.58	.010	0.45	.09	2.13	.034	0.32	.07	1.50	.134	0.23	.05	1.11	.268
	Monthly income† (ref: > 3,000,001)																
	≤ 1,000,000	-1.67	-.35	-4.16	< .001	-1.43	-.30	-3.76	< .001	-1.42	-.29	-3.72	< .001	-1.10	-0.23	-2.93	.004
	1,000,001 ~ 2,000,000	-1.15	-.23	-2.88	.004	-0.84	-.16	-2.20	.028	-0.82	-.16	-2.16	.031	-0.63	-.12	-1.71	.088
	2,000,001 ~ 3,000,000	-0.62	-.10	-1.42	.155	-0.52	-.08	-1.27	.203	-0.53	-.09	-1.32	.189	-0.41	-.07	-1.03	.302
B	Disability severity (ref: Mild)																
	Severe	-0.09	-.01	-0.10	.915	0.30	.02	0.38	.707	0.35	.02	0.45	.652	0.60	.03	0.79	.428
	Injured spinal region (ref: Lumbar)																
	Cervical	-0.37	-.08	-0.79	.428	-0.37	-.08	-0.85	.395	0.35	.07	0.80	.423	0.33	.07	0.77	.443
	Thoracic	-0.09	-.02	-0.21	.838	-0.15	-.03	-0.35	.728	0.07	.02	0.16	.871	0.11	.02	0.27	.788
C	Satisfaction with medical services					0.33	.32	7.79	< .001	0.30	.29	7.02	< .001	0.27	.26	6.32	< .001
D	Need for weight control									-0.14	.07	1.43	.155	-0.13	-.06	-1.36	.173
	Need for nutritional education									-0.28	.12	2.27	.024	-0.25	-.11	-2.04	.042
	Need for dietary management									-0.04	.02	0.28	.777	-0.01	-.01	-0.08	.935
	Disability acceptance									< .001	.01	0.18	.860	0.01	.02	0.42	.676
E	Frequency of exercising													0.19	.11	2.65	.008
F	Activity of daily living													0.02	.24	5.14	< .001
	R^2		.09				.19				.22				.27		
	adj R^2		.07				.17				.19				.24		
	F(*p*)		3.84 (< .001)				8.33 (< .001)				7.59 (< .001)				9.04 (< .001)		

†Unit is KRW, A=general characteristics, B=body functions and structures, C=environmental factors, D=personal factors, E=activity, F=participation.

sonal factors), higher frequency of exercise, and better performance in activities of daily living (activity and participation factors) were significantly associated with improved subjective health status. Subjective health status tends to vary by country, with individuals with SCI often reporting lower subjective health compared to the general population. For example, in the United States, approximately 21% of SCI patients rate their subjective health as "very poor" or "poor" [23]. In contrast, fewer than 10% among adults in Organization for Economic Cooperation and Development (OECD) countries and 12% among general population in Korea report their health as "very poor" or "poor" [24]. These disparities are not only attributed to the physical limitations experienced by SCI patients but are also exacerbated by psychological isolation and limited social participation [25]. The subjective health status of SCI patients is the result of a complex interplay of physical, psychological, and social factors. Therefore, improving subjective health status requires an integrated approach that combines medical treatment with psychological and social support as this study emphasized.

In the ICF model, environmental factors play a crucial role in ensuring that healthcare services reflect a disability-friendly environment for individuals with spinal cord injuries (SCI), which is closely linked to the provision of satisfactory health services. Prior study has identified health services and systems as the most frequently addressed environmental factors for community-dwelling individuals with SCI [13]. Moreover, personal satisfaction has been highlighted as an important criterion for evaluating the effectiveness of healthcare service delivery [15]. Given that individuals with SCI face a range of complex physical, emotional, and psychological challenges, providing comprehensive, multidisciplinary care is essential to meet their diverse needs. Effective healthcare services are not only crucial for managing the direct consequences of SCI, such as mobility limitations and respiratory complications, but also for preventing secondary health conditions, such as pressure ulcers, urinary tract infections, and cardiovascular issues, which are common in this population [26]. Additionally, individuals with SCI often experience significant social and emotional distress, including depression and anxiety, making mental health support an integral part of care [27]. Satisfactory healthcare services that are tailored to the unique needs of individuals with SCI can improve their quality of life, enhance independence, and foster a sense of well-being. However, improving healthcare service satisfaction among individuals with SCI requires focused efforts such as enhancing provider knowledge of SCI-specific needs, ensuring better accessibility to specialized care, and improving communication between patients and healthcare professionals. Providing patient-centered care that is culturally sensitive, accessible, and responsive to the needs of individuals with SCI can help bridge existing gaps in service delivery. Furthermore, healthcare service satisfaction is closely linked to better health outcomes, as individuals who are more engaged in their care tend to adhere to treatment plans more effectively and report greater overall health [21]. Ensuring accessible, patient-centered care that addresses both the physical and psychological aspects of SCI is essential for achieving optimal recovery and long-term health outcomes.

Given the personal factors in the ICF model, nutrition education plays a particularly critical role for individuals with SCI due to the unique challenges they face in managing their health and well-being. SCI often leads to changes in metabolism, muscle mass, and physical activity levels, all of which significantly affect nutritional needs [28]. A prior study also identified weight maintenance and general metabolic functions as challenges faced by individuals with SCI in context of long-term health care [13]. Proper nutrition is essential for preventing complications such as pressure ulcers, infections, and osteoporosis, which are prevalent in this population [29]. Furthermore, a balanced diet supports weight management, immune function [30]. However, many individuals with SCI often lack adequate knowledge about how to meet their nutritional requirements, making nutrition education a critical part of their rehabilitation process. To effectively deliver nutrition education, healthcare providers should consider personalized approaches that take into account the patient's specific functional level, lifestyle, and dietary preferences. This could include one-on-one counseling with a registered dietitian who has expertise in SCI, as well as the use of multimedia resources, such as telemedicine or interactive tools, that offer real-time feedback on proper nutrition and meal planning feedback [31]. Additionally, support groups or peer-led education programs can provide a valuable platform for individuals with SCI to share experiences and tips on managing nutrition within their unique circumstances [32]. Moreover, nutrition education should not be a one-time event but an ongoing process, with regular follow-ups to monitor progress and address any emerging concerns. Incorporating family members or caregivers into the education process can also improve the effectiveness of the intervention [33]. as they play a key role in meal preparation and overall health management. By providing accessible, personalized nutrition education and continuous support, healthcare providers can help individuals with SCI better manage their health, reduce the risk of secondary complications, and promote long-term recovery and subjective health status.

Activity and participation, as outlined in the ICF model, are fundamental to maintaining and improving subjective health status for individuals with SCI. Engaging in regular physical activity tailored to their functional level is crucial for maintaining and improving subjective health status. According to the WHO and evidence-based exercise guidelines for individuals with SCI, at least 150 minutes of moderate- to high-intensity physical activity are recommended three times per week [34]. Regular exercise enhances muscle strength, cardiovascular fitness, and joint mobility, which are essential for performing activities of daily living and preventing secondary health complications such as pressure ulcers and respiratory issues [35]. Moreover, exercise contributes to improved mental health, reducing anxiety and depression while increasing self-esteem, which in turn supports greater engagement in activities of daily living and subjective health status [36]. However, despite these benefits, many individuals with SCI face significant barriers to sustained physical activity. These barriers include limited access to adapted exercise equipment, lack of tailored exercise programs, and physical constraints due to the injury [37]. Additionally, individuals with SCI often experience a lack of motivation or psychological barriers, such as depression, which can hinder their willingness to engage in physical activity [25]. In response to these challenges, several intervention strategies have been shown to be effective. For example, a study by Sweet et al. demonstrated that community-based exercise programs that incorporate peer support and social interaction not only improve physical outcomes but also enhance participants' motivation and long-term adherence to exercise [38]. Similarly, the introduction of home-based exercise programs with personalized guidance from physiotherapists has been shown to significantly improve participation in physical activity for individuals with SCI, even in settings with limited access to specialized facilities [39,40]. Furthermore, adaptive equipment such as specialized wheelchairs, resistance bands, and exercise machines designed for individuals with SCI can enable individuals to engage in a variety of physical activities at home or in community centers, reducing barriers to access [37]. Healthcare providers must also address psychological factors, offering counseling and motivational support to combat feelings of depression or social isolation, which can negatively impact exercise engagement [25]. By incorporating these strategies, individuals with SCI are more likely to experience improved health outcomes, greater independence, and a higher subjective health status.

The novel approach applied in this study to identify the factors influencing subjective health status provides valuable multidimensional insights for healthcare provider, policy maker and individual with SCI themselves. However, it is important to consider several limitations in this study. First, the data analyzed reflect the subjective perceptions of individuals with SCI regarding their overall health status. While individual perceptions are important in evaluating health outcomes, self-reported data are susceptible to potential biases, such as social desirability or recall bias. Second, although various environmental factors may influence the subjective health status of individuals with spinal cord injury, this study considered only "satisfaction with medical services. Moreover, satisfaction with medical services was measured using a single-item question, limiting a comprehensive understanding of the factors contributing to participants' dissatisfaction with medical services. Finally, the study employed a cross-sectional design, which restricts the ability to establish causal relationships between the variables studied. Longitudinal studies would be necessary to explore causality more effectively.

Conclusions

In recent years, there has been a growing emphasis on the subjective health status of individuals with disabilities, shifting the focus away from the traditional healthcare provider perspective. This trend reflects a broader recognition of the importance of understanding health outcomes from the perspective of those who experience disability, as outlined in the ICF model. In response to this shift, this study employed ICF model to explore factors influencing subjective health status among individuals with SCI in South Korea. We consider factor as satisfaction with medical services (environmental factor), the need for weight control, the need for nutritional education, the need for dietary management and disability acceptance (personal factors) and exercise and activity of daily living (activity and participation factors) as components of ICF model. Our analysis found that satisfaction with medical services, the need for nutritional education, exercise, and activities of daily living were key determinants of subjective health status. These findings underscore the importance of a comprehensive, multidisciplinary approach to the care of individuals with SCI. Specifically, they highlight the diverse needs of individuals with SCI, who require tailored interventions addressing both physical and environmental aspects of their health. This insight can guide healthcare providers in offering more targeted support to improve the health outcomes of SCI patients.

ORCID

Haesun Lee, https://orcid.org/0000-0003-3947-3166
Hye Jin Nam, https://orcid.org/0000-0002-8907-9231
Ju Young Yoon, https://orcid.org/0000-0003-3944-0663

Conflict of interest

Ju Young Yoon has been an editorial board member of the Research in Community and Public Health Nursing. She was not involved in the review process of this manuscript. No conflict of interest has been declared by all authors.

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Authors' contributions

Haesun Lee contributed to conceptualization, data curation, formal analysis, methodology, validation, visualization, and writing-original draft, review & editing. Hye Jin Nam contributed to conceptualization, formal analysis, methodology, validation, and writing-review & editing. Ju Young Yoon contributed to conceptualization, funding acquisition, methodology, project administration, supervision, validation, and writing-review & editing.

Data availability

The datasets generated and/or analyzed in the current study are available in the repository of the Korea Spinal Cord Injury Association, where they will be provided upon request: http://www.kscia.org/kscia/

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