

Convergence Study on the Relationship between Kinesiophobia and Fear of Falling in Patients with Stroke

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뇌졸중 환자의 운동공포증과 낙상공포 사이의 관계에 대한 융합 연구

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Abstract This study aimed to investigate the convergence relationship between kinesiophobia and fear of falling in patients with stroke. A total of 113 patients with stroke participated in this study. Participants underwent inpatient rehabilitation and completed surveys with three different questionnaires including the fall efficacy scale (FES), translated Tampa Scale for Kinesiophobia 13 (TSK-13), and activity-specific balance confidence scale (ABC). TSK-13 and FES showed weak negative correlation ($r=-0.226$), and TSK-13 and ABC showed moderate negative correlation ($r=-0.300$). FES had a very strong positive relationship compared with ABC ($r=0.838$). Faller showed significantly low FES and ABC scores compared with non-faller ($p<0.05$). These results present that patients with stroke had mild kinesiophobia, and kinesiophobia is related to fear of falling. It is necessary to evaluate kinesiophobia in stroke rehabilitation.

Key Words : Convergence, Kinesiophobia, Fear of falling, Stroke

요약 본 연구의 목적은 뇌졸중 환자의 운동공포증과 낙상공포 사이에 융합적 관계를 조사하는 것이다. 총 113명의 뇌졸중 환자가 본 연구에 참여하였다. 참여자는 재활병원 입원환자로 낙상 효능감 척도(FES), 운동공포증을 위한 번역된 탐파 척도(TSK-13), 및 활동-특이성 균형 자신감 척도(ABC)를 포함한 3가지 다른 설문지를 작성하도록 요청하였다. TSK-13과 FES는 약한 음의 상관관계를 보였고($r=-0.226$), TSK-13과 ABC는 중등도 음의 상관관계가 나타났다($r=0.838$). FES는 ABC와 비교했을 때 매우 강한 양의 상관관계가 나타났다($r=0.838$). 낙상을 경험한 환자는 낙상을 경험하지 않은 환자보다 유의하게 낮은 FES와 ABC 점수를 보였다($p<0.05$). 이 결과는 뇌졸중 환자가 경증 운동공포증을 가지고 있으며, 운동공포증은 낙상공포와 관련이 있음을 제시하고 있습니다. 앞으로 뇌졸중 재활에 있어 운동공포증의 평가가 필요할 것으로 사료된다.

주제어 : 융합, 운동공포증, 낙상공포, 뇌졸중

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1. Introduction

Approximately 48% of inpatients with stroke at rehabilitation hospital complained to falls and pain during hospitalization, and about 50% reported chronic pain syndrome[1,2]. Nearly one-third of patients who had falls may have potentially serious injuries[3]. Falls in inpatients cause prolonged hospitalization with poor outcomes[4] because it induces a decrease in physical activity by fear of falling (FOF) and decline in self-esteem[5]. Approximately 88% of patients with stroke who have experienced falls have FOF[6] that is associated with poor mobility, deconditioning, decrease in functional abilities, and increase risk of another fall[5,7].

Liu et al. (2015) reported that FOF avoidance behavior is a good predictor of return to community in individuals with stroke[8]. The study suggested that the multidimensional interventions involving physical, psychological, and behavioral factors are necessary for community reintegration of patients with stroke undergoing rehabilitation. However, the previous study did not include fear avoidance of pain or injury.

Kinesiophobia is a term used in rehabilitation and physical therapy that describes fear of pain due to injury or re-injury, causing lack of physical activity[9]. Patients with kinesiophobia believed that movement generated re-injury with additional pain, which could easily lead to avoidance behavior, deconditioning, functional dysfunction, and depression[10].

The study of kinesiophobia in patients with stroke still remains unclear because only one study was conducted on patients with stroke and complex regional pain syndrome dealing with kinesiophobia[11]. Patients with stroke and pain have decreased cognition and function[12], low quality of life[2], high fatigue[13], and depression[14]. Pain is also a predictor of suicide in patients with stroke[14]. These previous

studies suggest that a study on pain and that associated with movement is necessary in stroke patients with stroke.

Stubbs et al. reviewed 12 studies that investigated FOF and pain in older adults[15]. The review provided evidence that pain would not only lead to avoidance of activities but also increase the FOF. A previous study on foot and ankle impairment in patients with chronic stroke have shown that pain and altered somatosensory function affect balance dysfunction, gait, and FOF[16]. However, there are still few evidences to demonstrate the relationship between pain and FOF.

Kinesiophobia and FOF lead to similar responses, such as avoidance behaviors. Fear-related avoidance behavior can decrease muscle strength, activities of daily living, and postural control ability[7]. Verma & Pal analyzed the relationship among pain, disability, and FOF in individuals with low back pain and demonstrated that pain increases FOF[17]. Although avoidance behaviors and pain have been proven to have a negative effect on rehabilitation, the evidence on the effects of kinesiophobia in patients with stroke was lack. Therefore, this study aimed to demonstrate the relationship between kinesiophobia and FOF in patients with stroke.

2. Materials and Methods

2.1 Participants and experimental procedure

This study is a cross-sectional study, and volunteers were recruited from multi-hospitals. The survey was conducted from November to December 2016. Patients with stroke who could understand the questionnaire items themselves and fill them out were included in the study. The exclusion criteria were other neurological diseases (Parkinson's disease and traumatic brain injury), systemic illness, and psychiatric deficits (dementia and depress).

All participants were informed of the purpose of this study and signed the consent form. The protocols and procedures were approved by the Bioethics Advisory Committee of Sahmyook University (2016104HR).

2.2 Experimental methods

The general characteristics of participants who met the selection criteria were evaluated, and the participants completed 3 different questionnaires: fall efficacy scale (FES), the Korean version of Tampa Scale for Kinesiophobia 13 (TSK-13), and activity-specific balance confidence scale (ABC). TSK-13 was translated to the Korean language by a bilingual professor; then, it was checked for comprehensibility, adaptability, and validation by a committee that consisted of researchers, professors, and experienced physical therapists. The translated FES and ABC were used in previous studies, and the reliability of FES ($r=0.904$) and ABC ($r=0.996$) was high[18].

All participants were provided with an explanation of the study aim and agreed to participate in the surveys. Physical therapists who were trained with the questionnaires only helped the participants when they did not understand an item. The questionnaires used unified terminology to reduce systematic errors. The general descriptive information and results of the 3 scales were analyzed.

2.3 Outcome measurements

2.3.1 Tampa Scale for Kinesiophobia 13 (TSK-13)

Fear avoidance due to pain was assessed using the self-report TSK-13 without item (number 4, 8, 12, and 16) which were known to improve psychometrics[19]. A higher TSK-13 score indicates the presence of a higher level of kinesiophobia. The scores were split into two subdivisions of harm score (item nos. 3, 4, 5, 6, 7, 9, and 10) and avoidance score (item nos. 1, 2, 8, 11, 12, and 13), and into four subgroups of

severity levels (subclinical scores 13–22, mild scores 23–32, moderate scores 33–42, and severe scores 43–52). The total TSK-13 scores were collected and used in the analysis.

2.3.2 Fall Efficacy Scale (FES)

The FES is a scale consisting of 10 items that measures an individual's degree of confidence related to falling during daily living activities[20]. Each item has a 10 scale measure ranging from 1 (unable to perform) to 10 (absolutely confident in performance). The total score was collected and used in the analysis.

2.3.2 Activity-specific Balance Confidence Scale (ABC)

The ABC is a self-report questionnaire that measures the individual's own perceived level of balance confidence during common indoor and outdoor activities of daily living. The scale has 16 items with an 11-level score in each item, ranging from 0% (not confident) to 100% (fully confident and does not lose balance during the activity)[21].

2.4 Statistical analysis

All statistical analysis conducted by SPSS version 18.0 software (IBM, Chicago, IL, USA).

Cronbach's α was used to evaluate internal consistencies of TSK-13, FES, and ABC, where intraclass correlation coefficient was used in measuring the test-retest reliability of TSK-13. The correlation coefficient r was used to determine all correlations in the study.

Moreover, independent t -test was used to analyze differences between groups with and without fall experience, and between groups with and without pain. A statistical significance level was set 0.05.

3. Results

3.1 General Characteristics of Subject

The demographic characteristics of the 113 participants are presented in Table 1.

Table 1. General characteristics of subjects

Variables	n(percent) or mean \pm SD
Gender (Male/Female)	77.00(68.1) / 36.00(31.9)
Age	63.41 \pm 15.08
Height	164.97 \pm 8.53
Weight	65.78 \pm 11.67
MMSE-K	24.83 \pm 5.34
Hemiplegic side (Right / Left / both or unspecified)	33.00(29.2) / 38.00(33.6) / 42.00(37.2)
Pain (Present / Not present)	76.00(67.3) / 37.00(32.7)
Location of pain (Shoulder / Back / Others)	26.00(34.2) / 15.00(19.7) / 35.00(46.1)
Fall (Present / Not present)	48.00(42.5) / 65.00(57.5)
Number of falls (Once / More than twice)	22.00(45.8) / 26.00(54.2)

MMSE-K, mini-mental state examination - Korean

3.2 Internal Consistencies and Test-retest Reliability of the Survey

Cronbach's α was used for measuring internal consistencies of 3 different scales. FES ($\alpha=0.951$) and ABC ($\alpha=0.971$) showed greater internal consistencies than TSK-13's ($\alpha=0.814$). To measure test-retest reliability of TSK-13, nine subjects were selected, and test-retest reliability of TSK-13 showed high with ICC of 0.854. Table 2.

Table 2. The Internal Consistency and Test-retest Reliability

Variables	α	ICC
TSK-13	0.814	0.854*
FES	0.951	-
ABC	0.971	-

3.3 Results of the Scales

The mean scores of the scales are presented on Table 3. The mean TSK-13 score was 31.62 \pm 7.17 with a possible maximum score of 52. In the subdivisions of TSK-13, the harm score

(18.11 \pm 4.06) was slightly higher than the avoidance score (13.51 \pm 3.94). The mean FES score was 61.29 \pm 25.60 with a possible total score of 100, and the mean ABC score was 633.27 \pm 445.18 with a possible total score of 1600. In Table 4, the total TSK-13 score was divided into 4 severity levels, mostly composed of mild to moderate levels of kinesiophobia similar to those in the previous study[22].

Table 3. Average scores of the scales

Variables	Mean \pm SD
TSK-13	31.62 \pm 7.17
Harm items	18.11 \pm 4.06
Avoidance items	13.51 \pm 3.94
FES	61.29 \pm 25.60
ABC	633.27 \pm 445.18

Table 4. TSK-13 severity levels

Variables	n (percent)
Subclinical scores (13-22)	17 (15.0)
Mild scores (23-32)	44 (38.9)
Moderate scores (33-42)	45 (39.8)
Severe scores (43-52)	7 (6.2)

3.4 Correlations among the Scales

The correlation coefficient between TSK-13 and FES was -0.226, but that between TSK-13 and ABC was slightly higher with -0.300. Both showed a negative relationship and had a statistically significant difference ($p>0.05$). FES and ABC showed a close relationship with $r=0.838$. Table 5.

Table 5. Correlation coefficients of TSK-13, FES, and ABC

Variables	TSK-13	FES	ABC
TSK-13, r(p)	-		
FES, r(p)	-0.226(0.016)	-	
ABC, r(p)	-0.300(0.001)	0.838(0.000)	-

3.5 Correlations among the Scales with Experience of Fall

The average number of falls in the subjects with fall experience was 2.25 ± 2.41 . Correlations among the 3 scales were highly similar in all subjects, but r slightly increased. The correlation coefficient between TSK-13 and FES was -0.226 . They showed a negative relationship but did not have a statistically significant difference. TSK-13 and ABC showed a statistically significant difference with $r = -0.323$. The relationship between FES and ABC showed a close relationship with $r = 0.817$. Table 6.

Table 6. Correlation coefficients of TSK-13, FES, and ABC in subjects with fall experience

Variables	TSK-13	FES	ABC
TSK-13, $r(p)$	-		
FES, $r(p)$	$-0.226(0.123)$	-	
ABC, $r(p)$	$-0.323(0.025)$	$0.817(0.000)$	-

3.6 Correlations among the Scales with Presence of Pain

Of 76 subjects with pain, 34.2% had pain in the shoulder region. Correlations in these subjects were weak. TSK-13 and FES did not show a significant correlation, but TSK-13 and ABC showed a significant correlation with $r = -0.241$. FES and ABC still showed a close relationship. Table 7.

Table 7. Correlation coefficients of TSK-13, FES, and ABC in subjects with pain

Variables	TSK-13	FES	ABC
TSK-13, $r(p)$	-		
FES, $r(p)$	$-0.149(0.198)$	-	
ABC, $r(p)$	$-0.241(0.036)$	$0.830(0.000)$	-

3.7 Differences in Means Scores of the Scales Regarding Fall Experience

There were no significant differences in the mean TSK-13 scores with respect to fall experience ($p = 0.082$). However, the result of TSK-13 showed observable differences, in which patients with fall experience showed higher total TSK-13 score. FES ($p = 0.044$) and ABC ($p = 0.010$) showed significant differences. Table 8.

Table 8. Differences in means of TSK-13, FES, and ABC in subjects with fall experience

Variables	Faller	Non-faller	t(p)	Cohen's d
TSK-13	33.00 ± 7.40	30.60 ± 6.88	$1.755(0.082)$	0.336
FES	55.63 ± 25.70	65.48 ± 24.91	$-2.041(0.044)$	0.389
ABC	508.96 ± 425.59	725.08 ± 440.07	$-2.630(0.010)$	0.499

3.8 Differences in Means Score of the Scales Regarding Presence of Pain

There was no significant difference in the 3 scales with respect to presence of pain patients with stroke in this study. However, patients with pain showed slight differences in scores with higher TSK-13 score and lower FES and ABC scores. Table 9.

Table 9. Differences in means of TSK-13, FES, and ABC in subjects with pain

Variables	Pain	Not pain	t(p)	Cohen's d
TSK-13	32.46 ± 7.70	29.89 ± 5.65	$1.804(0.074)$	0.380
FES	59.00 ± 24.51	66.00 ± 27.46	$-1.316(0.193)$	0.269
ABC	584.34 ± 439.98	733.78 ± 444.79	$-1.688(0.094)$	0.338

4. Discussion

Previous studies reported that FOF in patients with stroke and has negative effects including decline in physical activity, dignity, and functional ability[5,7]. Moreover, FOF can lead to additional risks of falling[1]. However, there was virtually no evidence on the effects of kinesiophobia, which has similar consequences as those of FOF, in patients with stroke. Verma & Pal (2015) reported that pain can increase FOF in patients with low back pain[17]. A review conducted by Stubbs et al.[15] also proposed that pain may increase the risks of FOF.

Therefore, this study aimed to investigate the relationship between kinesiophobia and FOF in patients with stroke. There were similarities in the avoidance behavior models of kinesiophobia[23] and FOF[24]. They both start from an experience of either pain or fall. These experiences will contribute to advanced disuse or disability with a form of depression due to fear of the episodes and related avoidance of activity develops. This fear can decrease muscle strength, performance of activities of daily living, and postural control of the patients[7]. To prevent these negative aspects, it is important to determine the possible fall risks involved in kinesiophobia and FOF.

In this study, relationship between kinesiophobia and FOF was estimated moderate (r between TSK-13 and ABC = -0.300). This result supports that of a previous study, which also investigated the relationship between kinesiophobia and FOF in patients with Parkinson's disease[25]. The translated TSK-13 was acceptable in patients with stroke because they were able to self-administrate the scale, and its internal consistency ($\alpha=0.814$) and test-retest reliability ($ICC=0.854$) were excellent. The internal consistency of TSK-13 was analogous to those of previous studies, ranging from 0.70 to 0.84[26,27]. The severity levels of TSK-13 was similar to the original study by most levels were mild (38.9%) and moderate

(39.8%)[22], suggesting the applicability of TSK-13 in patients with stroke in future studies.

In this study, 113 subjects were included, and the mean TSK-13 score was 31.62, with a harm score (mean 18.11) and avoidance score (mean 13.51). The scores were slightly lower than those in patients with Parkinson's disease, which showed a mean score of 37.7[25]. This difference was probably due to their effort in changing the term in their study as they changed the "pain" into "movement" variable and applied. Previous studies have found associations between high TSK-13 score and poorer performances in various physical activities[28-31], but they did not measure interactions effect between TSK-13 and FOF, which shares a similar cycle of catastrophizing and experience-related fear. Observed correlations of the scales may suggest a weak yet possible relationship between kinesiophobia and FOF. Both TSK-13 and ABC ($r=-0.300$) and TSK-13 and FES ($r=-0.226$) were significantly correlated ($p<0.005$) in all subjects.

The subjects with fall experiences had slightly high correlations, but not significant increase in the mean TSK-13 score in subjects with fall experiences compared to those who did not have fall experience. By the results of this study shown significant decrease in the mean scores of FES and ABC, fall experiences may have increased FOF as confirmed by the previous study[6]. ABC showed higher correlations with TSK-13 in all subjects. ABC was developed to supplement FES[21]. Jang et al.[18] reported in a previous study that ABC more precisely differentiated high levels of activity from those at lower levels than FES. Powell et al.[21] revealed that FES is insensitive to the evaluation of balance confidence in healthy older adults because a ceiling effect of the scale was present. Therefore, ABC may have shown better reflection of FOF compared to FES in this study.

However, the 3 scales showed weak correlation with regard to pain. This rejects one of our

hypotheses that was set prior to this study. There were no observable differences in the mean TSK-13 scores between the subjects with pain and those without pain. However, the mean TSK-13 score was higher than those in all patients and patients without pain. Pain may contribute to kinesiophobia in patients with stroke, but this was not significant in this study. This result may be associated with a previous study that pain may not be specifically associated with higher TSK-13 scores but more to disability[32].

It was meaningful to observe that not only fall experience but also the presence of pain experience had an effect on both FES and ABC scores. The patients with pain were lower than those without pain in mean FES and ABC scores. Lower scores in patients with pain show lower efficacy of balance, which is suggesting higher possibility of FOF. This may provide evidence that pain in patients with stroke contributes to FOF as confirmed by the result of a previous study by Stubbs et al. on older adult populations[15].

This study had some limitations. A higher number of subjects is still needed to meet the “rule of 10” and obtain more precise results of the survey[33]. Moreover, FES and ABC effectively measures the FOF in the subjects but only in terms of their confidence[34]. They cannot predict the actual physical abilities and precise fall risks of the patients[34].

This was the first survey study designed to investigate the relationship between kinesiophobia and FOF in patients with stroke. This study may suggest that patients with stroke who experienced fall during rehabilitation had both kinesiophobia and FOF. The relationship was higher in TSK-13 and ABC. Physicians and therapists involved in rehabilitation should acknowledge the presence of kinesiophobia and adjoin treatments of psychological disorder within multidimensional interventions.

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