Cuadernos de Neuropsicología / Panamerican Journal of Neuropsychology
2022, Vol. 16 Nº1 48 - 56

ISSN: 0718-4123
DOI: 10.7714/CNPS/16.1.202

EVALUATION OF THE PREDICTOR FACTORS OF FALL EFFICACY SCALE IN CHRONIC STROKE SURVIVORS

Evaluación de factores predictores de la "Fall Efficacy Scale" en supervivientes de accidentes cerebrovasculares crónicos

Avaliação dos fatores de predição da "Fall Efficacy Scale" em sobreviventes de acidente vascular cerebral

RECIBIDO: 16 noviembre 2021 ***ACEPTADO: 31 diciembre 2021***

Cansın Medin-Ceylan[a] ***Tugba Sahbaz[b]***

a. MD, Department of Physical Medicine and Rehabilitation, Istanbul Physical Medicine and Rehabilitation Training Research Hospital, Istanbul. Turkey **b.** MD, Department of Physical Medicine and Rehabilitation, Kanuni Sultan Süleyman Training and Research Hospital, Istanbul, Turkey.

Keywords: Adaptation; Validation; Normative Data; Scales for Argentine population

Palabras Clave: Adaptación; Validación; Datos Normativos; Baremos para población Argentina.

Palavras-chave: Quedas acidentais; equilíbrio; derrame cerebral; reabilitação; autoeficácia; qualidade de vida.

A B S T R A C T

Objective: To determine the associating factors of fall and the correlations between Fall Efficacy Scale (FES), balance, motor recovery, ambulation, cognitive function and quality of life (QOL). Method: This is a cross-sectional observation study. 146 chronic stroke participants were divided into two groups as fallers and non-fallers. Demographic characteristics, fall events, FES, Berg Balance Scale, Functional Ambulation Category, Functional Independence Scale, Brunnstrom stages, Modified Ashworth Scale, Mini-mental state examination, Stroke Impact Scale were measured. Results: Subjects with fall history had poorer balance, motor recovery and cognitive function; more fear of falling and low QOL than non-fallers (p<0.001). The ROC curve analysis revealed that FES could differentiate stroke patients based on fall history at a cut-off score of 38.5. Significant correlation was observed between FES with age, stroke type, motor evaluation, QOL and cognitive function. Conclusions: The FES could differentiate people with stroke with fall history, balance deficiency, lower functional mobility and higher disability.

Correspondencia: Cansın Medin-Ceylan, MD, Department of Physical Medicine and Rehabilitation, Istanbul Physical Medicine and Rehabilitation Training Research Hospital, Istanbul, Turkey. Phone: +90531 5759539, e-mail: cansinmedin@hotmail.com

Cuadernos de Neuropsicología / Panamerican Journal of Neuropsychology ISSN: 0718-4123
2022, Vol. 16 Nº1 48 - 56 DOI: 10.7714/CNPS/16.1.202

R E S U M E N

Objetivo: Determinar los factores asociados a la caída y las correlaciones entre la Fall Efficacy Scale (FES), el equilibrio, la recuperación motora, la deambulación, la función cognitiva y calidad de vida (QOL). **Método:** Se trata de un estudio de observación transversal. Se dividió a 146 participantes con accidentes cerebrovasculares crónicos en dos grupos: caedores y no caedores. Las características demográficas, los eventos de caídas, la FES, Escala de equilibrio de Berg, categoría de deambulación funcional, escala de independencia funcional, estadios de Brunnstrom, escala de Ashworth modificada, mini examen del estado mental, Se midió la escala de impacto del accidente cerebrovascular. **Resultados:** Los sujetos con antecedentes de caídas tenían peor equilibrio, recuperación motora y función cognitiva; más miedo a las caídas y una baja calidad de vida que los no caídos (p<0,001). El análisis de la curva ROC reveló que el FES podía diferenciar a los pacientes con ictus en función del historial de caídas con una puntuación de corte de 38,5. Se observó una correlación significativa entre la FES y la edad, el tipo de ictus, la evaluación motora, la calidad de vida y la función cognitiva. **Conclusiones:** El FES podría diferenciar a las personas con ictus con historial de caídas, deficiencia de equilibrio, menor movilidad funcional y mayor discapacidad.

R E S U M O

Determinar os fatores associados à queda e as correlações entre a "Escala de Eficácia de Quedas" (FES), o equilíbrio, a recuperação motora, a deambulação, a função cognitiva e qualidade de vida (QOL). Método: Trata-se de um estudo de observação transversal. Os 146 participantes com acidentes vasculares cerebrais crônicos foram divididos em dois grupos: com quedas e sem quedas. As características demográficas, os eventos de quedas, a FES, a Escala de Equilíbrio de Berg, categoria de deambulação funcional, escala de independência funcional estágios de Brunnstrom, escala de Ashworth modificada, mini-exame de estado mental e a Escala de impacto do AVC foram medidos. Resultados: Os sujeitos com antecedentes de quedas tinham pior equilíbrio, recuperação motora e função cognitiva; mais medo de cair e uma baixa qualidade de vida que os 'sem quedas'. A análise da curva ROC demonstrou que a FES poderia diferenciar os pacientes com derrame cerebral em função do histórico de quedas com uma pontuação de corte de 38,5. Foi observada uma correlação significativa entre a FES e a idade, o tipo de derrame, a avaliação motora, a qualidade de vida e a função cognitiva. Conclusões: A FES poderia diferenciar às pessoas com derrame e histórico de quedas, deficiência de equilíbrio, menor mobilidade funcional e maior deficiência.

Introduction

Stroke is one of the most common causes of acquired adult disability (Duncan et al., 2011). Stroke may cause physical impairments such as weakness, paralysis, sensory disturbances, and impaired postural control. It can also cause mental fatigue, depression and impaired cognitive function. Both physical and mental impairments can contribute to a fall (Larén, Odqvist, Hansson, & Persson, 2018). After a stroke, falls are one of the most common medical complications with a 73% incidence within the first six months (Denissen et al., 2019). Fall rates increase significantly because of poststroke mobility deficits, motor and sensory impairments, and residual functional, cognitive, and emotional deficits. These deficits are often related to mobility impairments and declines in activities of daily living (ADL), social participation, and quality of life. Falls aggravate poststroke residual impairments and the decrease of abilities to complete ADL (Schmid & Rittman, 2009). Also, falling is a major threat to stroke patients for physical injury. Fracture resulting from falling, could affect the rehabilitation potential and functional recovery (Hyndman, Ashburn, & Stack, 2002; Suzuki et al., 2005).

Fear of falling (FOF) is defined as persisting concern regarding falling (Batchelor, Mackintosh, Said, & Hill, 2012; Schinkel-Ivy, Inness, & Mansfield, 2016). Compared with age-matched controls, people who have experienced a stroke are significantly more likely to report FOF (Goh, Nadarajah, Hamzah, Varadan, & Tan, 2016). There is a reported prevalence of 32–83% for FOF between the first six months and four years after stroke (Goh et al., 2016; Schmid et al., 2015). The prevalence of FOF is higher among women than among men (Goh et al., 2016).

In addition to physical components, psychological factors related falling include fear of falling (Batchelor et al., 2012).It also causes avoidance of activities and a loss of confidence (Schmid et al., 2011). Although the consequences of falls are well documented, only a few qualitative research has described the relationship among chronic poststroke deficits, poststroke falls and fear of fall. Therefore, it is important to identify and explore the determinants and associated factors of fear of fall in patients with stroke. Hence, this study was designed to evaluate the predictors of fear of fall in adult patients with stroke.

ISSN: 0718-4123
DOI: 10.7714/CNPS/16.1.202

Methods and Participants

The current single-center, cross-sectional observational study was conducted in a total of 146 chronic stroke survivors who were referred to the Department of Physical Medicine and Rehabilitation for stroke rehabilitation between March 2018 and December 2020. We divided the participants into two groups: fallers and non-fallers.

Inclusion criteria for these patients were as follows: aged 18 years or older, first-ever stroke, post- stroke duration <6 months, patients who experienced a single ischemic or hemorrhagic stroke in the cerebral hemisphere as confirmed by computed tomography or magnetic resonance imaging scans, Functional Ambulation Category (FAC) scores ≥3 points, Mini-Mental State Examination (MMSE) score of ≥18 and being able to verbally communicate, patients who were able to walk 10m with or without any assistive device (Folstein, Folstein, & McHugh, 1975).

Exclusion criteria for patients were as follows: poor visual acuity, severe aphasia, neurological deficits due to causes other than cerebral infarction, patients who had serious underlying medical conditions that might affect mobility training, severe unilateral neglect, abnormalities of the vestibular system, musculoskeletal disorders that might affect motor performance, uncooperative or unable to comply with instructions on test procedures.

All participants signed a written consent prior to participation in the study. The study was approved by the local institutional review board. Clinical trial has been registered by Clinical Trials Registry (NCT04688060). The study was conducted in accordance with the Declaration of Helsinki ethical principles for human experimentation.

Demographic characteristics and medical history recorded by questionnaire included age, height, weight, marital status, educational level, comorbidities, date of stroke onset, weakness side and type of stroke (hemorrhagic or ischemic). Falls history included number of falls during last 6 months. Fear of falling was assessed by FES. Also balance, functional ambulation levels, motor functions, spasticity and quality of life were assessed using Berg Balance Scale (BBS), Functional Ambulation Category (FAC), Brunnstrom staging, Functional Independence Measurement (FIM), Modified Ashworth Scale (MAS), Stroke Impact Scale 3.0 (SIS).

Outcome Measures

The BBS was used to assess postural control and balance of the participants. The BBS consists of 14 items scored on a 5-point ordinal scale, ranging from 0 to 4 (0 indicates lowest level of function; 4 indicates highest level of function), with a maximum total score of 56. Total scores of items were used in this study. A higher score indicates a better mobility performance (Sahin et al., 2008; Stevenson, 2001).

The FES was used to assess the level of fear of falling during indoor or outdoor activities. It has 16 items scored on a four-point Likert scale (1=not at all concerned to 4= very concerned). The Turkish validated version of the FES was used in this study. The total score (sum of the 16 responses) ranging from 16 to 64 points was used for data analysis. A higher score indicates better mobility performance (Ulus et al., 2012). A cut-off score of 27 points on the 16- item FES was used to differentiate high concern of falling from low concern in the elderly (Delbaere et al., 2010).

Participants' functional ambulation levels were evaluated using the FAC, which has been validated in persons who have had a stroke. The FAC describes the individual's walking ability, which ranges from independent outdoor walking to nonfunctional walking (i.e., unable to ambulate or ambulates only in parallel bars). The scale is rated from 1 to 5 points, with the higher scores indicating better walking ability. A cut-off score of 4 points in the FAC was found to be sensitive in predicting community ambulation (Mehrholz, Wagner, Rutte, Meissner, & Pohl, 2007).

Brunnstrom stages was used to evaluate the motor functions of the participants. Brunnstrom stages evaluates motor movement patterns and motor functions in stroke patients according to stages. In the scale, there are 6 stages that evaluate the motor development of the upper extremity, lower extremity and hand (Brunnstrom, 1966).

Spasticity of the patients was evaluated using the Modified Ashworth scale (MAS). MAS provides a clinical measure of the amount of muscle resistance during passive joint motion. It is scored between 0 and 4 (Ansari, Naghdi, Younesian, & Shayeghan, 2008).

Stroke Impact Scale 3.0; aims to evaluate the perception of quality of life after stroke by the patients themselves or their caregivers. It is a patient-centered quality of life measure specific to stroke. It consists of 8 subsections and 59 questions. Each question is scored by evaluating the difficulty experienced in the last week on a 5-point scale. The score for each section ranges from 0 to 100. In addition to 8 subsections, it includes the evaluation of perception of recovery after stroke with a visual analog scale of 0-100 points (0: no improvement, 100: complete recovery (Hantal, Doğu, Büyükavcı, & Kuran, 2014) .

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Cognitive functions of the patients were evaluated with the MMSE. In the 11-item test, each question is worth one point and is evaluated over the total score of 30 (Folstein et al., 1975). It is stated that in the test, which has a total score of 30, 23 or less points indicate cognitive impairment and will assist in the safe and sensitive investigation of cognitive functions in the early stages of dementia (Folstein et al., 1975; Küçükdeveci, Kutlay, Elhan, & Tennant, 2005).

Results

A total of 146 patients (64 females, 82 males) were enrolled to the study. The mean (SD) age was 62.73 (11.40) years, disease duration was 43.8 (46.42) month. The results showed that there was a statistically significance in the age, gender, stroke type, weakness side, Brunnstrom stage, FIM, FAC, BBS, FES, MAS, MMSE and SIS scores in the faller compared to the non-faller (p<0,05), but there was no significance in the body mass index, time since stroke, marital status (p>0,05). The values are summarized in Table-1-2.

Table 1

Demographic and clinical characteristic of participants

	Non-faller (n, %)	**Faller (n, %)**	**X2**	**p-value**	**All (n, %)**	**FES score** ***Mean ± SD(Min/Med/Max)***	**p-value**
Gender			5,312	0.021*			<0,001*
Male	17(31.5)	47(51.1)			64(43.8)	37,56±10,12 (21/36/61)	
Female	37(68.5)	45(48.9)			82(56.2)	47,31±11,57 (29/51/62)	
Marital status			2,702	0.100			0,179
Single	12(22.2)	11(12)			23(15.8)	39,26±12,54 (25/36/62)	
Married	42(77.8)	81(88)			123(84.2)	42,31±11,63 (21/39/61)	
Stroke type			19,550	<0.001*			<0,001*
Ischemic	34(63)	85(92.4)			119(81.5)	43,40±12,00 (21/41/62)	
Hemorrhage	20(37)	7(7.6)			27(18.5)	34,92±7,80 (25/32/52)	
Weakness side			4,654	0.037*			0,949
Right	38(7.04)	48(52.2)			86(58.9)	41,93±12,43 (21/38/62)	
Left	16(29.6)	44(47.8)			60(41.1)	41,70±10,89 (25/39,5/61)	

FES: Fall Efficacy Scale; SD: Standart deviation; Min:Minimum; Med:Median; Max:Maximum

A high positive correlation was found between the FES with age (r = 0.384), MAS-UE (r = 0.429) and MAS-LE (r = 0.384). A high negative correlation was found between the FES with Brunnstrom arm (r = -0.375), hand (r = -0.425), leg (r = -0.397), BBS (r = -0.382), FIM (r=-0.611), FAC (r=-0.449) SIS (r = -0.587) and MMSE (r = -0.426). Also there was no correlation between body mass index (r = -0.058), time since stroke (r = 0.074) and weakness side (r = -0.005). The values are summarized in Table-2.

ISSN: 0718-4123
DOI: 10.7714/CNPS/16.1.202

Table 2

Correlations Between Variables and FES

FES: Fall Efficacy Scale; SD: Standart deviation; Min:Minimum; Max:Maximum; BBS:Berg Balance Scale, FIM:Functional Indepence Measurement; SIS:Stroke Impact Scale. FAS:Functional Ambulation Scale; MMSE:Mini-Mental State Examination; MAS-UE:Modified Ashworth Scale-Upper Limb; MAS-LE:Modified Ashworth Scale-Lower Limb.

	Non-faller (n=54)	Faller (n=92)	p-value	All (n=144)	FES (r)	FES Correlation p value
Age (years)			0.001*			
Mean ± SD	59.04±7.77	64.89±12.62		62.73±11.40	0.364	<0.001*
Median (min-max)	57(43-80)	65(35-84)		63(35-84)		
Time since stroke(months)			0.956		0.074	0.373
Mean ± SD	41.11±33.73	45.46±52.57		43.85±46.42		
Median (min-max)	29(6-109)	24(6-228)		24(6-228)		
Brunnstrom stage arm			0.025*		-0.375	<0.001*
Mean ± SD	4.05±1.49	3.43±1.66		3.66±1.62		
Median (min-max)	4(1-6)	3(1-6)		3(1-6)		
Brunnstrom stage hand			0.014*		-0.425	<0.001*
Mean ± SD	3.55±1.72	2.80±1.84		3.08±1.83		
Median (min-max)	4(1-6)	2(1-6)		3(1-6)		
Brunnstrom stage leg			0.006*		-0.397	<0.001*
Mean ± SD	4.29±0.86	3.89±0.87		4.04±0.88		
Median (min-max)	4(3-6)	4(3-6)		4(1-6)		
BBS (scores)			<0.001*			
Mean ± SD	37.96±5.67	32.85±7.95		34.74±7.59	-0.382	<0.001*
Median (min-max)	40(22-46)	33(18-49)		35(18-49)		
FIM (scores)			0.035*			
Mean ± SD	95.37±27.10	86.84±24.75		90.67±25.88	-0.611	<0.001*
Median (min-max)	97(27-126)	95.5(39-125)		96(27-126)		
SIS-Total (scores)			0.020*			
Mean ± SD	61.67±13.37	55.89±14.91		58.02±14.58	-0.587	<0.001*
Median (min-max)	63.79(32.41-89.43)	55.27(28.72-91.85)		58.10(28.72-91.85)		
FAS			0.019*			
Mean ± SD	4.96±0.72	4.67±0.75		4.78±0.75	-0.449	<0.001*
Median (min-max)	5(4-6)	4.5(4-6)		5(4-6)		
MMSE (scores)			<0.001*			
Mean ± SD	25.17±6.09	21.16±6.72		22.72±6.75	-0.426	<0.001*
Median (min-max)	27(8-37)	23(6-30)		25(6-37)		
MAS-UE (scores)			<0.001*			
Mean ± SD	0.61±0.87	1.32±1.14		1.06±1.10	0.429	<0.001*
Median (min-max)	0(0-3)	1(0-4)		1(0-4)		
MAS-LE (scores)			0.013*			
Mean ± SD	0.94±0.86	1.42±1.11		1.24±1.05	0.384	<0.001*
Median (min-max)	1(0-2)	2(0-4)		1(0-4)		

Cuadernos de Neuropsicología / Panamerican Journal of Neuropsychology
2022, Vol. 16 Nº1 48 - 56
ISSN: 0718-4123
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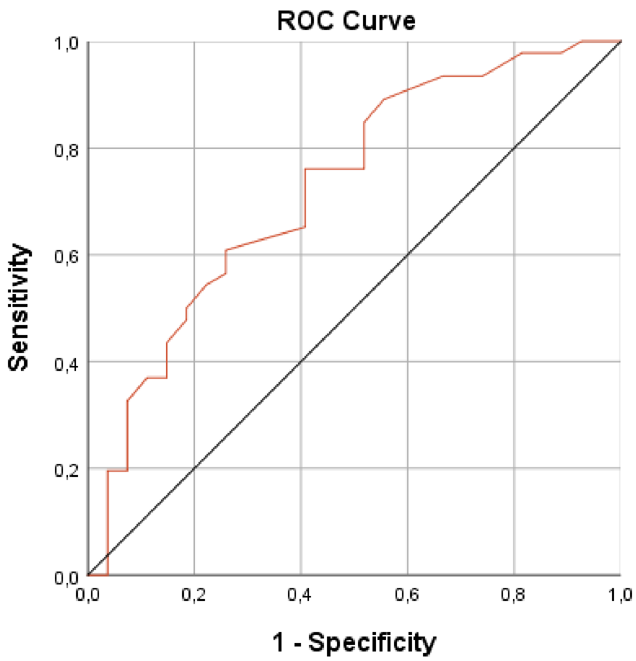
The ROC curve analysis revealed that the FES distinguished people with stroke with and without a history of fall at a threshold score of 38.5 (sensitivity, 60.9%; specificity 74.1%) and an AUC of 0.725 (Fig.1).

Figure 1

Receiver operating characteristic (ROC) curve for the FES to discriminate between stroke patients with and without history of fall



	AUC (95%)	Cut off	p	Sensitivity(%)	Specifity(%)
FES	0.725(0.639-0.812)	38.5	<0.001	60.9	74.1

Discussion

In stroke patients, FOF could constitute a mobility barrier that impairs participation in daily living activities and adaptation to the rehabilitation program. Therefore we believe it is important for rehabilitation team to assess FOF in stroke patients. The present study examined the predictor factors of fall and fear of fall in adult patients with stroke. Statistical significance was found in the evaluations of age, gender, stroke type, weakness side, fear of fall and balance, ambulation, motor function, spasticity, cognitive impairment and quality of life in the evaluation performed between fall and non-faller patients. There was no statistical significance time since stroke, BMI and marital status. The results of this study also showed that there were highly correlation between fear of fall and balance, ambulation, spasticity, cognitive function, motor function and quality of life.

After a stroke, falls are one of the most common medical complications with a 73% incidence within the first year (Denissen et al., 2019). At the same time, stroke survivors often develop psychosocial issues from falling. The most common are depression and fear of falling, which can further reduce their level of activity leading to further physical deconditioning and loss of independence (Watanabe, 2005; Xu et al., 2018).

In the present study the falling rate was evaluated as 63% and found subjects who had fallen to have higher levels of FES and to be more likely to be afraid of falling as compared with those who had not fallen. It is well recognized that persons who experience multiple falls are more likely to be afraid of falling (Belgen, Beninato, Sullivan, & Narielwalla, 2006). Several studies also report that stroke patients with a history of falling are likely to have higher levels of fall-efficacy than those without a history of falling (Andersson, Kamwendo, & Appelros, 2008; Belgen et al., 2006). Considering the falls were associated with falls efficacy, rehabilitation interventions should also be incorporated to improve falls efficacy for stroke

 ISSN: 0718-4123
DOI: 10.7714/CNPS/16.1.202

survivors (Tsai, Yin, Tung, & Shimada, 2011). These findings suggested that interventions to improve functional ambulation and balance may be play a critical role in both fall prevention and fall self-efficacy.

Falls self-efficacy is associated with balance and other physical performance variables, and likely with stroke recovery. Just as Hellström et al found in the first year poststroke, we also found falls-efficacy to be correlated to poststroke balance in participants with chronic stroke (Hellström, Nilsson, & Fugl-Meyer, 2001).

After a stroke, gait patterns are frequently slow and spatiotemporally asymmetric. This is purported to lead to decreased balance, which is of particular concern, as impaired balance can subsequently lead to falls and injury (Michael, Allen, & Macko, 2005; Olawale, Usman, Oke, & Osundiya, 2018; Persson et al., 2018).

In a poststroke population, Michael et al found reduced daily ambulation to be related to both decreased gait speed and balance (Michael et al., 2005). Similarly, statistical significance was established in the faller with FAC. Also there was a high correlation between FAC and FES. This study revealed that the FES could differentiate people with stroke based on fall history at a cutoff score of 38.5. This a study to calculate cut-points for stroke patients of concern about falling. By using related measures of previous falls history as state variables, it proved feasible to derive FES cut-points of concern. In order to better understand the way in which stroke people use the FES to report their concern, data-driven cut-points are crucial.

Motor impairment, can be understood as a limitation of function in terms of muscle control, movement or mobility and can affect the movement control of the affected side of the body. Motor impairment, while clinically thought to increase risk of falls, but it is unclear whether motor impairment is a risk factor for falls. Motor impairment assessed by Brunnstrom was not found to be associated with falling by Langhorne P. et al (Langhorne, Coupar, & Pollock, 2009). In contrast to this, statistical significances were found in the evaluations of motor impairment assessed by Brunnstrom stage arm, hand and leg.

In this study, fall experience was not associated with the time after stroke. Neurological recovery in stroke patients occurs within the first month to three months, and spontaneous improvements in balance and walking are usually completed in 3-6 months (Lee et al., 2015). In present study, in order to minimize the contribution of the spontaneous recovery process in the balance assessment of stroke patients, our participants were in the chronic stage (>6 months poststroke). Although chronic patients have limited mobility or inefficient or unsafe gait, they regain their walking skills and become relatively independent in their daily lives. The absence of a relationship between the time passed after the chronic phase and the history of falling can be explained by the stabilization in the healing process.

While the risk of falls is associated with increasing age in community older adults Langhorne P et al. showed no relationship between age, gender and all fallers among community stroke survivors (Langhorne et al., 2009). Against to this study, we found significant relationships between age, female gender and falling.

These findings were in present study that the side of paresis was important to predict the risk of falls and fall efficacy. The patients with ambulatory ability with left hemiplegia/hemiparesis were more vulnerable to falls after a stroke as reported by a recent studies (Lim, Jung, Kim, & Paik, 2012; Rosario, Kaplan, Khonsari, & Patterson, 2014). In contrast, Oğuz et al, found a negative correlation between balance and left hemiplegia in individuals with chronic stroke (Oguz et al., 2017). A stroke in the nondominant hemisphere (the right hemisphere, in most people), may lead to reduced self-awareness, anosognosia, and neglect. Patients with a right-sided stroke can therefore be expected to report less FOF due to possible impairments in disease and self-awareness (Larén et al., 2018).

As mentioned, the study focused on determining the correlation between the falls efficacy and the related factors for stroke survivors. Ischemic stroke type were correlated with the falls efficacy. However, it should be noticed that because most of these infarction stroke survivors were taking anticoagulants, like warfarin, the consequences of falls could be serious. It is possible the falls could cause these patients to be more fearful of falling (Tsai et al., 2011).

Tianma Xu et al. showed that impaired balance, mobility and disability in self-care were strongly associated with falling among stroke survivors living in the community, while depression, cognitive impairment, and history of fall were moderately associated with falling among this population (Xu et al., 2018). In present study, There was statistical significance in all these data (balance, ambulation, motor function, cognitive impairment and quality of life). Falls could result in a decline in daily activities and decrease survivors' quality of life (Roe et al., 2009). The QOL of patients with stroke was affected by FOF (Batchelor et al., 2012; Schmid & Rittman, 2009; Schmid et al., 2011).

Even in the absence of any physical complications after a fall, the feeling of insecurity and fear leads the person to an inactive and sedentary position and causes deterioration in quality of life. The present study found subjects who had fall history with stroke to have lower levels of SIS and there was also a positive correlation between FES and quality of life. Fear of falling has been found to lead to avoidance behaviors and reduced community reintegration in patients who have had a stroke (Liu, 2015).

ISSN: 0718-4123
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Furthermore, FOF was associated with not only the physical factors but also the psychological factors. In this study, statistical significance was found in stroke patients with a history of falling in cognitive impairment assessments assessed by MMSE, and also determined the correlation between falling effectiveness and cognitive evaluation. Cognitive impairment after stroke is common; almost one out of four stroke survivors have some cognitive impairment in the first three months after a stroke. Furhermore In addition, awareness of safety may be reduced in stroke survivors with cognitive impairment, which can lead to post-fall injury and requires more attention from family members or other caregivers (Haring, 2002; Xu et al., 2018).

Interventions to improve functional ambulation and balance may play a critical role in both fall prevention and fall self-efficacy. In addition to physical therapy intervention, cognitive behavioral therapy that focuses on cognitive restructuring has been found to be effective in reducing fear of falling (Zijlstra et al., 2009). Although further studies are needed, it may be helpful that the evaluation and treatment of these physical and psychological factors with FOF could improve the QOL of the stroke patients.

Study Limitation

MMSE was used in the cognitive evaluation of patients. More sensitive cognitive tests than MMSE should use in identifying stroke survivors with cognitive impairments after stroke. The inclusion and exclusion criteria aimed to include independently walkers who had a stroke. Our sample of stroke survivors is, to some extent, biased towards the higher functioning stroke survivors and will not reflect all ambulatory walking stroke survivors.

Participants with cognitive dysfunction or language problems were excluded from the study, so these results cannot be generalized to institutionalized patients or those with cognitive deficits or language problems. Finally, the study was cross-sectional in nature; thus, the findings do not necessarily reveal a causal relationship between fall efficacy and balance ability at the time of the fall.

The study design was cross-sectional that limits considering future falls for discriminative ability. The history of falling was considered, but the future falls were not accounted. Follow up study is required to assess the discriminative ability of FES for predicting future falls. In addition, the number of falls were not considered for the discriminative ability of FES. Future studies should assess the discriminative ability of FES in distinguishing multiple fallers from subjects with a single fall.

Conclusion

Stroke patients with a history of falling were significantly more likely to experience fear of falling. This study highlights the need to assess FOF in persons who have had a stroke and identifies the risk factor associated with fear of falling. On the basis of these findings, strategies can be developed to address FOF remedying the potentially modifiable risk factors identified in this study.

Author Information

Cansın Medin-Ceylan https://orcid.org/0000-0003-1552-8986, Physical Medicine and Rehabilitation Training and Research Hospital, Kocasinan Merkez Mah. Karadeniz Cad.No 48, 34147, Bahcelievler, Istanbul, Turkey, 05315759539, cansinmedin@hotmail.com

Tugba Sahbaz https://orcid.org/0000-0002-5974-8991 Kanuni Sultan Süleyman Training and Research Hospital, Istanbul, Turkey, 05368289936, piskint@gmail.com

ISSN: 0718-4123
DOI: 10.7714/CNPS/16.1.202

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