

ความสัมพันธ์ระหว่างการทำหน้าที่ด้านร่างกายและการหกล้มในผู้สูงอายุ โรคหลอดเลือดสมอง 3 เดือนหลังจำหน่ายจากโรงพยาบาล

Relationships between Physical Functions and Falls in Older Adults with Stroke at Three Months after Discharge

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บทคัดย่อ

การวิจัยเชิงบรรยายครั้งนี้ มีวัตถุประสงค์เพื่อศึกษาอุบัติการณ์การหกล้ม และความสัมพันธ์ระหว่าง ความสามารถในการทำกิจวัตรประจำวัน การเดิน การทรงตัว แรงบีบมือ และการหกล้มในผู้สูงอายุโรคหลอดเลือดสมอง 3 เดือนหลังจำหน่ายจากโรงพยาบาล กลุ่มตัวอย่างเป็นผู้สูงอายุโรคหลอดเลือดสมอง อายุ 60 ปีขึ้นไป จำหน่ายจากโรงพยาบาล 3 เดือน จำนวน 130 ราย ที่เข้ารับการรักษาในโรงพยาบาลระดับตติยภูมิและโรงพยาบาลมหาวิทยาลัยในจังหวัดชลบุรี เครื่องมือที่ใช้ในการวิจัย ได้แก่ (1) แบบสอบถามข้อมูลส่วนบุคคลและข้อมูลการหกล้ม (2) แบบประเมินการทำกิจวัตรประจำวันดัชนีบาร์เธลเอดีแอล (3) Time Up and Go Test (4) Berg Balance Scale และ (5) การทดสอบแรงบีบมือ วิเคราะห์ข้อมูลโดยใช้ สถิติสหสัมพันธ์แบบเพียร์สัน สถิติสหสัมพันธ์แบบสเปียร์แมน และสถิติไคสแควร์ ผลการศึกษาพบว่าจากกลุ่มตัวอย่าง 130 ราย มีผู้หกล้ม 67 ราย (ร้อยละ 51.54) ในช่วง 3 เดือนหลังจำหน่ายจากโรงพยาบาล การทำหน้าที่ด้านร่างกายที่มีความสัมพันธ์ในระดับสูงกับการหกล้มอย่างมีนัยสำคัญทางสถิติ ได้แก่ ความสามารถในการทำกิจวัตรประจำวัน ($r = -.621, p < .001$), การเดิน ($r = .628, p < .001$), และการทรงตัว ($r = -.616, p < .001$) แรงบีบมือมีความสัมพันธ์ลบในระดับน้อยกับการหกล้มอย่างมีนัยสำคัญทางสถิติ ($r = -.283, p < .001$) และแรงบีบมือในเพศหญิงมีความแตกต่างกันระหว่างกลุ่มที่มีการบาดเจ็บจากการหกล้มและกลุ่มที่ไม่มีการบาดเจ็บจากการหกล้มอย่างมีนัยสำคัญทางสถิติ ($p < .05$)

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Abstract

A descriptive study was used to estimate the incidence and examine the association between activities of daily living, gait, balance, hand grip strength, and falls in older adults with stroke at three months after discharge. One hundred thirty older adults with stroke receiving follow up sessions at a tertiary hospital and a university hospital in Chonburi. The study instruments included (1) The demographic and falls information questionnaire (2) Barthel Activities of Daily Living Index (3) Time Up and Go Test (4) Berg Balance Scale, and (5) Hand grip strength. Data was analyzed using Pearson product-moment correlation, Spearman's rank correlation, and Chi-square test. The findings of this study revealed that out of 130 participants, 67

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participants (51.54%) had falls in the first three months after discharge. Strong was the relationship between falls and physical functions including activities of daily living ($r = -.621, p < .001$), gait ($r = .628, p < .001$), and balance ($r = -.616, p < .001$). The relationship between hand grip strength and falls was weak ($r = -.283, p = .001$). There was significant difference in hand grip strength among females between fall related injured group and non-fall related injured group ($p < .05$).

Keywords: Physical functions, Falls, Older adults with stroke

Introduction

Falls in older adults with stroke could result in a variety of complications. This kind of incidence had 10-20% probability to turn into injuries in older adults and it also contributed up to 5% as a cause of hospitalizations in older adults over 65 years of age.¹ Fall-related injuries could result in poor recovery and give older adults disabilities from which they may not fully recover afterwards.²

There are still higher incidence of falls at three months after discharge in older adult with stroke.³ Older adults also fall more often than those who are younger.^{4,5} They had their own specific risk factors for falls that were different from other populations. The risk factors consisted of age-related changes and the pathological features of the stroke itself.⁶ Most of them had impaired motor nervous system, which may be caused by signal transmission failure from cerebral cortex, chronic brain injury, and muscle atrophy from patient's excessive inactivity.⁷ As a result of the impairment, older adults after a stroke were found to have poor muscle tone, poor muscle strength, poor balance, and nervous system incoordination. These outcomes could lower their mobility and put more strain on their physical functions.⁸ If we combined those elements with the activities during post-stroke rehabilitation, such as early ambulation and task-specific movement training, the risk of falls could be augmented.

The physical function was the most common risk factor of falls which could be assessed through

investigating daily living activities, gait, balance, and hand grip strength.⁹ Older adults with reduced daily activities, achieved a low score on Berg Balance Scale, spent a long time on Timed Up and Go Test, and decreased in Hand grip strength had a statistically significantly higher risk of falling.^{10,11,12,13} Gerontological Nurse Practitioners (GNP) had an important role in preventing falls from happening. However, even though older adults recovering from a stroke have received a comprehensive stroke rehabilitation program, especially during their first three months after discharge from the hospital, the incidence of falls still persisted.³ Be it the ineffectiveness or a lack of fall protection, they may potentially reduce rehabilitation development. Therefore, GNP should take part in the recovery process with new approaches to further ensure that the risk of falls would be reduced, and that is essential during the rehabilitation phase of stroke recovery in older adults. This study aimed to estimate the incidence of falls and examine the correlation between physical functions and falls as a guideline for GNP or other health care providers to encourage older adults with stroke to maintain their physical ability as much as possible.

Research Objectives

1. To estimate the incidence of falls in older adults with stroke at three months after discharge.
2. To examine the correlations between

physical functions and falls in older adults with stroke at three months after discharge.

Methods

A cross-sectional study was conducted to estimate the incidence of falls and examine the correlation between physical functions (activities of daily living, gait, balance, and hand grip strength) and falls in older adults with stroke at three months after discharge and visited Burapha University Hospital and Chonburi Hospital, which are tertiary and secondary hospitals respectively, for follow-up during December 2021 to May 2022.

Samples

A purposive sampling technique was used to recruit the prospective sample. Inclusion criteria on sample selection were: 1) patients must have cognitive intact evaluated by using the 6-item Cognitive Impairment Test–Thai version with a score of seven or lower¹⁴ 2) older adults age 60 and over with ischemic or hemorrhagic stroke 3 months after discharge and 3) patients must be able to communicate in Thai. Prospective participants who had a history of hip osteoarthritis, knee osteoarthritis, other skeletal or neurological disorders would be excluded. The sample size was calculated on the G*power version 3.1.9.6 package program.¹⁵ A review of the literature found that falls were related to activities daily living ($r = -.383$, $p = .008$),¹⁶ gait ($r = .446$, $p < .005$),¹⁷ balance ($r = -.445$, $p < .005$),¹⁷ and hand grip strength ($r = -.254$, $p = .003$).¹⁸ The relationship between falls and hand grip strength was the lowest. Therefore, it was used to determine the effect size (Effect size) equal to 0.254. An 80% power analysis, an alpha of .05. When the value is calculated with a program, the sample size was 119 participants. In case the sample withdraws or the information is incomplete, the researchers

increased the sample size by approximately 15 percent. Finally, there were 130 participants in this study. The proportion of the samples from each hospital is based on the number of stroke older adults admitted to both hospitals from September to December 2021. There are 242 cases at Chonburi Hospital and 83 cases at Burapha University Hospital. The proportion was 96 participants enrolled from Chonburi Hospital and 34 participants enrolled from Burapha University Hospital with a total of 130 participants.

Research Instrument

1. **Falls history record book** including age, gender, body mass index, marital status, educational level, monthly income, residential characteristics, underlying conditions, medication use, length of stay in hospital for stroke treatment, and history of falls in the past 3 months

2. **The Modified Barthel Activities of Daily Living Index: MBI**¹⁹ consists 10 activities. Each item receives a score from zero to three points. The Modified Barthel Activities of Daily Living Index scores range from 0 to 20 points, Low score is interpreted as poor ability to function. In this study, the Cronbach's alpha coefficient was .86 for 130 participants.

3. **Time Up and Go Test: TUGT** used to assess walking ability. In TUGT participants are asked to rise from a standard armchair, walk to a marker 3 meters away, turn, walk back to the chair, and sit down again. The score is the time in seconds that participant takes to complete the course. If participants spend more time on the test, it reflects they have more physical mobility deficit.²⁰ The test-retest correlation coefficients for TUGT scores in older adults with stroke was .95. While TUGT was correlated with the Berg Balance Scale ($r = -.81$), gait speed ($r = -.61$) and the Barthel Index of ADL ($r = -.78$).¹²

4. Berg Balance Scale: BBS used to measure both the static and dynamic aspects of balance. It consists of 14 activities. Each activity has five choices with rating scale from zero to four points, zero points indicating an inability or need more assistance to complete the task and 4 points indicating independence and performing confidently to complete the task. BBS scores range from 0 to 56 points, Low scores indicate poor balance.²¹ In this study, the Cronbach's alpha coefficient was .97 for 130 participants.

5. Hand grip Strength used to measure muscle strength of both hands and forearms by using Digital dynamometer grip - D T.K.K.5401. Participants were asked to squeeze it as hard as possible for 3 seconds and do it twice on each hand at least 2 minutes apart then read the test value in kilograms. The mean of two trials of each hand was measurement in this study and the mean hand grip strength was calculated from the value of both hands. Low scores indicate poor hand muscle strength.²² Interpretation of results compared to standard values of relative hand grip strength to body weight (kg/body weight). Using the criteria of older adults aged 60 years and over and gender to classified.²³

Statistical analysis

Demographic and falls information were analyzed by using employing descriptive statistics. Pearson's product moment correlation and Spearman's rho correlation were used to examine the relationship between physical functions and number of falls. Chi - Square and Fisher's Exact test were used to compare physical functions between groups with fall injuries and without a fall injury.

Ethical consideration

This research protocol was approved by the Institutional Review Board (IRB) of the Faculty of

Medicine Ramathibodi Hospital, Mahidol University (COA. MURA2021/806), the Faculty of Medicine, Burapha University Hospital (HS071/2564), and Chonburi Hospital (2/65/O/q). All participants have signed the consent form before attending this study. The participants have also given their verbal consent and understood the right to call off from the study without providing any explanations. The consent form process was completed before starting the data collection phase. The participant's anonymity and confidentiality were well protected. All the forms were kept anonymous. All data was stored in a secure place and only utilized for the purpose of the research. The results were reported as group data.

Results

There were more male participants than females (60% and 40% respectively). The age of older adults who participated varied between 60 - 89, with an average of 70.8 (SD = 7.32). Half of them had a normal BMI level. 90.77% of participants were diagnosed with at least one disease while the most common disease was hypertension (88.14%). 61.21% of participants took four or more drugs, while the most common ones were antihypertensive drugs (86.21%). There were 67 older adults (51.54%) who had falls during the first three month after discharge.

The average age of the 67 participants who experienced falls was 73.28 years (SD = 0.921), while 28 of them were women (41.79%). By categorizing the frequency of falls during the study period, 35 participants, counted as 52.24% of the patients who fell, reported that they have experienced falls once. The severity of injuries incurred during falls would be divided into a group of 44 fallers (65.67%) with no injuries and the other 23 (34.3%) with injuries. Almost half of fall injuries turned out to be minor injuries, such as bruises/abrasions (76.19%). The most common area for falls to occur was reported to be the area

inside the participants' houses (62.69%) and then bedrooms (31.34%). Flat surfaces were the area's most common characteristic where falls occurred (92.42%). Sudden muscle weakness was suspected

to be the most prevalent causes of falls, which accounted for 82.09%. The most prevalent time reported for falls was during the middle of the day (71.64%), as shown in Table 1.

Table 1 Frequency, percentage of number of falls, falls characteristic, severity, location, location characteristic, falls cause, and time (n = 67)

Falls related information	n	%
Number of falls		
1 time	35	52.24
2 times	21	31.34
≥ 3 times	11	16.42
Severity of injuries * (More than 1 answer possible)		
No injury	44	65.67
Bruises/Abrasions	32	76.19
Laceration/Sprains/Strains	10	23.81
Fractures/Dislocations/ Hospitalization	2	4.76
Location * (More than 1 answer possible)		
Other room Inside home	42	62.69
Bedroom	21	31.34
Outside home	13	19.40
Bathroom	8	11.94
Location characteristic * (More than 1 answer possible)		
Flat floor	61	92.42
Stair, step	10	15.15
Flat floor with obstacles	2	3.03
Cause * (More than 1 answer possible)		
Muscle weakness	55	82.09
Trip step	9	13.43
Dizziness/Syncope	5	7.46
Trip obstacle	4	5.97
Slip wet floor	4	5.97
Unsuitable shoes	1	1.49
Time * (More than 1 answer possible)		
Morning	24	35.82
Day	48	71.64
Evening	5	7.46
Night	7	10.45

Forty-four participants who falls without injury, most of them possessed a mild to moderate level of self-dependency (37.31%), dependent mobility level (16.42%), and good balance (16.42%). Most male participants had low to very low hand grip strength (33.34%), while the females had low to very low hand grip strength (28.57%). A significant difference could only be detected in hand grip strength in females between the group with fall injuries and the group without ($p < .05$). On the other hand, there were no significant differences among ADLs, gait, and balance between the two groups ($p < .05$).

There was a significant relationship between the activities of daily living, gait, balance, hand grip strength and falls in older adults three months after discharge. An inversion variation was detected between these variable and falls incidence. The strong positive relationship between these three variables and falls was found (Activities of daily living ($r = -.60$, $p < .001$), gait ($r = .62$, $p < .001$), balance ($r = -.62$, $p < .001$)). On the contrary, the negative relationship between hand grip strength and falls was weak ($r = -.261$, $p = .003$), as shown in Table 2.

Table 2 Relationships between physical functions and number of falls in older adults with stroke (N = 130)

Variable	Number of falls	
	r	p-value
Activities of daily living	rs = -.621	< .001
Gait	rs = .628	< .001
Balance	rs = -.616	< .001
Hand grip strength	r = -.283	.001

r = Pearson’s test; rs = Spearman’s rho Correlation test

Discussion

The results indicate that, among 130 participants, there are 67 persons (51.54%) who experience falls after being diagnosed with a stroke during the age of 70 - 79 years old (46.30%), which is similar to the study in New Zealand conducted with a middle-old participant group.²⁴ The cause might be the biological deterioration of people due to their middle-old age that tends to lead to the development of more medical conditions, which result in more drug intake compared to the youngest-old group. The middle-older group is also more dependent to others than their younger counterpart. However, they could still maintain more independence than people in the oldest-old group.²⁵ In this study, most of participants had hypertension, diabetes, and hyperlipidemia which

may increase musculoskeletal conditions.²⁶ In addition, older adults with stroke are found to have low muscle tone, less muscle strength, poorer balance, and degenerated nervous system coordination. Hence, these conditions have decreased patients’ mobility and made their daily activities hard to independently perform.⁸ To conclude, these factors can increase the risk of falls.

This study reveals that half of the participants have already fallen over at least once. A previous study’s results supported the current findings that stroke patients had a high probability of falling during the six months period after their stroke occurred.²⁷ Most of the participants did not sustain any injuries or were only slightly hurt (bruises and scratches). According to other studies, stroke patients received

no injuries after falling.²⁸ On the other hand, as for some patients who did get injured, their injuries were not significant.³ This might result from an attentive rehabilitation that the healthcare providers have provided during the first three months after discharge.²⁹ As a result, older adults were fully motivated to practice physical therapies and occupational therapies. Furthermore, they were given advice on how to avoid any risky environment that could lead to falls.³⁰ Consequently, when falling occurred, most older adults were not hurt or only had insignificant injuries.

Daily living was negatively correlated with the number of falls at a significant level. There is not only biological degeneration that increases the risk of falling, but having a stroke also plays a role. Stroke patients normally suffer from a loss of muscular and neurological functions, which put limits on how they perform their daily living. Nonetheless, there is not a noticeable correlation between the activity of daily living and the severity of fall injuries. Unlike the previous studies, which found that daily activities were statistically predictive of falls-related injuries,³¹ the high self-dependency group reported that they had low fear of falling, were not careful while doing activities in daily life, and had no family members who could pay close attention to them. As a result, it was found that they had serious injuries from falls. On the contrary, the group with low self-dependency will be restricted from doing any activities or even using walking aids. Therefore, the severity of the injury from falls was only minor.

Gait was significantly correlated in the positive direction with the number of falls. Previous studies suggested that older adults who have fallen over one or more times significantly took more time to complete the tasks in TUGT.³² The results described that older adults had unequal stepping and spent more time on the stance phase during gait.

Furthermore, the older adults' arm swing was low, especially in stroke patients with muscle weakness. Additionally, their knees could suddenly fold during the stance phase, which might eventually cause falls.³³ Ultimately, there is no correlation between gait period and the severity of the fall injury. However, older adults with impaired gait could possibly have more serious injuries than the ones who could perform gait normally. Another finding showed that older adults with poor gait ability were afraid of falling, so they raised their vigilance to prevent themselves from falling over.³⁴ Some even restricted themselves from doing any activities and depended on walking assistance.³⁵ This might be the cause of the difference in injury level of the participants.

Balance was significantly correlated in a negative direction with the number of falls. The previous study found that stroke patients with low BBS scores were more at risk of falling.¹¹ This might be explained by the fact that balancing requires coordination among the vestibular system, somatosensory system and musculoskeletal system.³² Due to age-related biophysical changes as well as the pathological symptoms of stroke, those systems may not function properly.⁷ Balance, on the contrary, did not have any significant correlation with severity of injuries associated with falls. This study has revealed a different outcome despite the results of the previous studies. The outcomes showed that the participants who had poor balancing ability have received support from their relatives. Moreover, as they were unable to properly balance their bodies, they were provided with walking assistance to limit their unnecessary movement. That might be the reason why the participants in question did not sustain any fatal injuries from falling. On the other hand, the other participants who still had normal balance did not have any of their relatives to aid them when they were in need. With their lack of support before and

after falling, the latter group of participants have suffered from more serious injuries than the poor balancing ones.

Hand grip strength was significantly correlated with the number of falls. Hand grip strength could imply one's muscle strength.³⁵ As a result, having lessened muscle strength, especially around one's upper muscle area, could correlate to falling.³⁶ The weakened muscle was a reflection in daily living limits which lead to impaired movement and eventually falling.³⁷ Hand grip strength in female was significantly correlated to the severity of injuries associated with falls. This may be explained by the more rapid muscle loss in female patients in middle-old group than that of men's because the former naturally had smaller muscle fibers and some other age-related changes.³⁸ In addition, older stroke patients did not have enough strength to support themselves when they fell over. They were not capable of reaching walking assistance, furniture, or walls to minimize the damage of their falls. Thus, hand grip strength could potentially predict the severity of falling.³⁹

Implications for the Study Findings

According to the results of this study, more than half of the participants fell at three months after discharge from hospital. Therefore, healthcare providers should focus on preventing falls from related factors in this group. In this study, it was found that physical functions were falls related factors consisted of activities of daily living, gait, balance, and hand grip strength. Therefore, promoting these factors can be done by

1. Encourage older adults with stroke to maintain their physical ability as much as possible.
2. Promote exercises that can improve balance such as Tai Chi, walking with weights, stretching, ballroom dancing, or swimming, etc.

3. Encourage gait training to improve their gait pattern, speed, and coordination of skeletal, muscular, and nervous systems such as body-weight supported treadmill training which can help them walk safely and provide stability.

4. Promote hand grip strength by recommending to use weak hand to perform basic daily activities such as holding a spoon and fork during meals, opening bottle caps, and twisting doorknobs, etc.

Recommendations for Further Study

1. This study focused on the risking factors, such as daily living, gait, balance and hand grip strength, during the 3-month period after discharge. A further 6-month follow-up session should be conducted to deepen the understanding the correlation between falling and those factors.

2. Studies involving the risking factors (daily living, gait, balance and hand grip strength) are considered as important factors to improve falling prevention programs in older adults with stroke after their discharge for 3 months.

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