Factors Influencing Home Modification of Stroke Patients

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Background: Home modification for stroke victims is often necessary to prevent falls and enable them to have a better quality of life. Up-to-date relationship between personal factors and home modifications in post-stroke patients has not been investigated.

Objective: To identify significant personal factors influencing the requirement for home modification in post-stroke patients.

Study design: Prospective, analytical study.

Material and Method: Two hundred eighty one post-stroke patients were recruited from nine tertiary rehabilitation centers in Thailand. All patients received inpatient rehabilitation programs until either they reached the rehabilitation goals or registered two consecutive stable weeks as measured by their Barthel index score. Personal factors related to home modification were assessed at study entry, during hospital stay and at discharge. The correlation between personal factors and necessities of home modification in post-stroke patients were reported through univariate and multivariate modeling.

Results: The results of univariate analysis showed that a low Barthel index score ($\leq$ 14/20) (at baseline and discharge), low Brunnstrom stage of arm or leg ($\leq$ IV/VI) at baseline, and intolerance to intensive rehabilitation programs (< 3 hr/day) indicated a necessity for modifications in the patient's home (p < 0.05). The results of multivariate modeling showed that a low Barthel index score (at baseline and discharge), and intolerance to intensive rehabilitation were significant predictors of a requirement for home modification (p < 0.05).

Conclusion: A low level of physical functioning and intolerance to intensive rehabilitation are significant predictors for the necessity of home modifications in stroke victims.

Keywords: Stroke, Home modification, Factor

Stroke is one of the leading causes of death and long-term disability in the world, including Thailand[1]. More than 60% of stroke survivors suffer from persistent neurological deficits that impair the activities of daily living (ADLs)[2]. After a stroke, the motor function of the lower extremities is often impaired, leading to restrictions in functional mobility. Almost all stroke patients need rehabilitation, which focuses primarily on enhancing physical and psychological functions, and improving their quality of life based on biopsychosocial models (BPS)[3]. In 2001, the World Health Organization (WHO) adopted a new system, the International Classification of Functioning, Disability and Health (ICF), for classifying health and health-related domains[4]. The ICF emphasizes the important influence of contextual factors on levels of functioning and classifies them as either personal

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factors such as age or sex, or environmental factors such as physical barriers[5]. Home modification for stroke victims is often necessary to enable them to have the best quality of life possible with their new disability, in which the living environment is intentionally changed to increase safety, ease of use and the capability of the victim to help themselves[6]. Such modifications to the home environment can be a key factor in helping the post-stroke patients feel secure and independent in their home. This feeling of security helps improve their daily life, as they can be comfortably and securely active in moving around their home as much as they desire[7].

To date, the relationship between personal factors and home modifications in post-stroke patients has not been investigated. The objective of this research was to identify significant personal factors influencing home modification in post-stroke patients.

Material and Method
Subjects

To obtain the data for the present study, the authors undertook a prospective study of stroke survivors between March and December 2006.

Participating organizations were 9 tertiary care hospitals in Thailand (King Chulalongkorn Memorial Hospital, Maharaj Nakorn Chiangmai Hospital, Pramongkutkloa Thai Army Hospital, Prasat Neurological Institute, Ramathibodi Hospital, Sirindhorn National Medical Rehabilitation Center, Siriraj Hospital, Songklanagarind Hospital, and Srinagarind Hospital). Patients with a clinical diagnosis of ischemic or hemorrhagic stroke and who otherwise met the inclusion criteria were individually chosen by a physiatrist from each participating hospital. The inclusion criteria were stroke patients aged 18 or over, stable vital signs for at least 48 hours prior to the beginning of rehabilitation, being able to follow at least a one-step command, being co-operative with their rehabilitation, and able to sit without dizziness or vertigo for at least 30 minutes. The authors excluded patients with a severe medical condition such as severe dementia, uncontrolled heart disease, schizophrenia, or multiple disabilities, or who had suffered a severe complication while at the hospital and required referral to a medical ward. Informed consent was obtained from all participating subjects.

Method

Initial evaluations were made within 3 days of a patient's admission and final evaluations were made 1 day before discharge. Participants provided demographic information (sex, age, marital status, educational level, number of co-morbid conditions, cohabitation), and stroke characteristics (type of stroke, side of hemiparesis, onset) were obtained from the medical chart.

Baseline cognition function was assessed for all subjects using the Thai version of the Mini Mental State Examination (TMSE)[8]. The TMSE was used as a screening instrument to separate the patients into two groups, those with and those without cognitive impairment. The test has scores in a range from 0-30, and the authors defined cognitive impairment as a score below 24[9].

Using the Barthel index, performance of the subjects' daily routines, particularly the activities involved with daily living(ADLs) and mobility, was assessed on the first day of the program and then once a week until discharge[10]. Subjects were rated, using a numeric-point scale, on their ability to perform 10 items: eating, personal hygiene, bathing, getting dressed, toileting, transfer, bowel control, bladder control, moving from the wheelchair to bed, and walking along, up/down the stairs. Scores ranged from 0-20, with higher scores indicating a better level of functioning.

Mood disorder was assessed at baseline and discharge for all participants using the Hospital Anxiety and Depression Scale (HADS)[11], specifically developed for use in patients with somatic co-morbidity, consisting of 7-item subscales for both depression and anxiety. HADS items are rated on a 4-point scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). The items are summed to provide a total score. Scores of 0-7 in respective subscales are considered normal, with 8-10 borderline and 11 or more indicating patients are at risk of clinical anxiety or depression. Higher scores reflect more anxiety or depressive symptoms.

Quality of life (QOL) was also assessed at baseline and discharge for all participations using the WHO-QOLBREF-THAI, a generic and transcultural QOL assessment instrument developed by the WHO. This is a 26-item scale with each item having a 5-point Likert response, having two global scales (Q1 and Q26) and four subscales measuring physical health, psychological well-being, social relationships, and satisfaction in the environment. The four subscale scores are calculated by summing up the scores of the subscale items. In the present study, the authors classified the scores into three QOL groups using criteria developed by Mahatnirunkul[12].

Spasticity was assessed at baseline and then every week until discharge using the modified Ashworth scale (MAS), the most widely used method for assessing muscle spasticity in clinical practice and research[13]. In this test, two muscle groups in each upper and lower limb are tested using a standardized procedure, and the results rated on a 6-point scale ranging from 0 (no increase in muscle tone) to 4 (affected part rigid in flexion or extension).

Motor recovery was assessed at baseline and discharge for all participants using the Brunnstrom Motor Recovery Stages instrument, the most widely used method for assessing motor recovery in clinical practice and research[14]. For this test, two muscle groups in each upper limb (hand and arm) and one muscle group in each leg are tested using a standardized procedure, and the results rated on a 6-point scale ranging from 1 (flaccidity) to 6 (isolated voluntary movement).

All of the patients who participated in the present study participated in some type of rehabilitation program, depending on their specific situation, i.e. one or more of range of motion exercises, strengthening exercises, balance training, ambulation training, self-care training, speech training, and psychosocial supports. The rehabilitation continued until the patient reached the desired discharge criteria, which would be reaching the rehabilitation goals and/or gaining stable scores on the Barthel index for two consecutive weeks. Before discharge, the subjects and caregivers were asked questions about planned home modifications and then classified into two groups according to their home modification plans.

Data analysis

Demographic data (sex, age, marital status, educational level, co-morbid conditions, and stroke characteristics (type of stroke, side of hemiparesis, cognitive function, perceptual function, and communication problems) were obtained from the medical chart.

The baseline factors noted for purposes of the present study were sex, age, side of hemiparesis, number of comorbid conditions, presence of depression and/or anxiety, the Barthel index scores, the Brunnstrom stages of hand, arm and leg, spasticity in the upper and lower extremities, perceptual dysfunction, communication problems, and level of quality of life.

Any complications during the hospital stay were recorded, but the authors were mainly interested in eight complications that are known to be the main influences on home modifications. They are the shoulder pain, back pain, knee pain, neuropathic pain, pressure sores, pneumonia, urinary tract infection, and deep vein thrombosis (DVT).

The factors of interest at discharge were the presence of depression and/or anxiety, the Barthel index score, the Brunnstrom stages of hand, arm and leg, spasticity in upper and lower extremities, level of quality of life, and the ability to tolerate the intensive rehabilitation programs the patient had received.

After being discharged, the subjects were classified into two groups according to the home modifications.

Statistical analysis

Statistical analysis was carried out using SPSS version 11.01 (SPSS Inc., Chicago, IL).

The main analyses were based on mean $\pm$ standard deviation (SD) and frequencies. Pearson's Chi-squared test was used to assess the correlation between two categorical variables. Multiple logistic regressions and odds ratio with 95% confidence interval (95% CI) were used to model the relationships between the home modification (outcome) and the various determinants at baseline, during hospital stay and discharge. A p-value less than 0.05 was considered statistically significant.

Results

There were 376 patients referred to the rehabilitation wards of the study hospitals during the study period. Of these, 327 patients met the inclusion criteria and were accepted for participation in the present study, and 281 (85.93%) eventually completed the present study. The flow of the present study, including the status of the patients at the end of the present study, is depicted in Fig. 1.

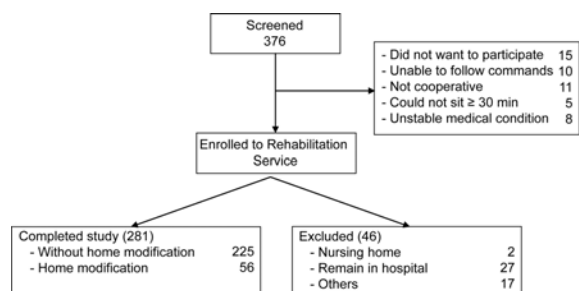Demographic data of the subjects are shown in Table 1.

Fig. 1 Flow of the study

Table 1. Demographic data

Variables	Number of subjects (%)
Age	62 ± 12*
Sex	
Male	158 (56.2)
Female	123 (43.8)
Chronic condition	
Hypertension	212 (39.0)
Dyslipidemia	154 (28.3)
Diabetes	79 (14.5)
Heart disease	53 (9.7)
Previous stroke/TIA	46 (8.5)
Type of stroke	
Ischemic	204 (72.6)
Hemorrhagic	77 (27.4)
Hemiparetic side	
Left	154 (54.8)
Right	120 (42.7)
Bilateral	5 (1.8)
No weakness	2 (0.7)
Cognitive function	
Low	167 (59.4)
Normal	114 (40.6)
Perceptual dysfunction	
Neglect syndrome	58 (43.0)
Proprioceptive sense	32 (23.7)
Hemianopia	25 (18.5)
Visual neglect	20 (14.8)
Communication problem	
Speaking impairment	105 (45.5)
Writing impairment	77 (33.3)
Reading impairment	28 (12.1)
Listening impairment	21 (9.1)

* Reported as mean ± standard deviation

The correlations between personal factors and home modification in post-stroke patients are summarized in Tables 2. Moreover, no positive correlation between complications during hospital stay and home modification in post-stroke patients was found in the present study.

Table 3 presents the results of multivariable modeling. A low Barthel index score (at baseline and discharge), and intolerance to intensive rehabilitation programs were significant home modification predictors.

Discussion

Home modification is necessary for many post-stroke victims. According to the ICF classification, there are two groups of factors that interfere with functioning and ability in post-stroke patients, personal and environmental factors[6]. In the present study, the authors focused only on personal factors. A low Barthel index score and patient inability to tolerate an intensive rehabilitation program were the significant factors related to home modification.

Table 2. Associations between home modification and personal factors at baseline and discharge

Variables	Home modification (%)		p-value
	No	Yes	
At Baseline			
Barthel index			
Low score (0-14)	73.3	92.9	0.03
High score (15-20)	26.7	7.1	
Brunnstrom stage (arm)			
Grade I-IV	76.0	92.9	0.04
Grade V-VI	24.0	7.1	
Brunnstrom stage (leg)			
Grade I-IV	81.2	96.2	0.04
Grade V-VI	18.8	3.8	
At Discharge			
Barthel index			
Low score (0-14)	44.4	73.2	0.01
High score (15-20)	55.6	26.8	
Toleration of intensive rehabilitation			
Yes	80.5	58.3	0.02
No	19.5	41.7	

Two hundred and twenty-five post-stroke patients (80.1%) reported that home modifications were not necessary. Only 56 patients (19.9%) had to modify their home. Most participants from both groups returned to their previous housing, so overall the percent of home modifications in the present study was quite low. Hazler and Barwick reported about 30% of stroke victims required home modifications within the first 3 months after onset, and this figure increased over time[15]. The authors speculate that perhaps the low percent of home modifications required in the presented patients may have been because most of the presented patients had both a high Brunnstrom stage recovery and a high Barthel index score (≥ 15/20), which would indicate that the stroke resulted in only minimal impact on ADLs or ambulation. Alternatively, it may also be related to the fact that more than half of the presented patients were elderly, and in the Thai culture, which commonly has large, extended families living in one dwelling, the presented stroke victims

Table 3. Multivariate logistic regression model: relationship between major personal factors and home modification

Variable	Odds ratio (95% CI)	p-value
Low Barthel index score (admit)	1.84 (1.21-2.45)	0.04
Low Barthel index score (discharge)	2.67 (1.82-3.10)	0.02
Intolerance to intensive rehabilitation	2.14 (1.57-2.83)	0.03

had many family caregivers to help them, making house modifications less urgent than in patients from cultures with less family support.

The Brunnstrom recovery stage instrument is the most widely used tool worldwide to assess the motor recovery of poststroke patients. The presented report noted a high percent of home modifications in the group with low Brunnstrom stages (grades I-IV) when compared with high Brunnstrom stages (grades V-VI) of hand, arm, and leg. Kotoh et al compared Brunnstrom stages with ADLs and ambulation with similar results[16].

Spasticity is an indirect finding that can sometimes be used to predict motor recovery[17]. In patients with poor stroke recovery there is usually prominent spasticity. In the present study, the authors found no correlation between spasticity and home modifications in univariate analysis. These findings indicate that spasticity alone is probably not a good predictor for home modification because many treatments such as oral antispastic drugs, botulinum toxin injection, or orthoses may decrease spasticity.

The Barthel index score instrument is increasingly used worldwide because of the good inter-rater reliability and ease of recording[18]. A direct measurement between task and functioning may be recorded by using this tool. Furthermore, it is a good predictor for home modifications. Because using the Barthel index is represented by the performance of the subjects' activity daily of living and mobility, so the lower scores indicating a lower level of functioning. In the group in the present study with low Barthel index scores (0-14), there were a high percentage of home modifications compared with the group in which home modifications were not necessary. Interestingly, in the group with high scores (15-20), the authors found fewer patients who had to modify their home. This may be from the subjects in this group having a higher level of functioning. Some studies have reported a good correlation between high scores on the Barthel index and FIM and ability to do ADLs and mobility[19].

The ability of patients to perform rehabilitation programs in the present study was reported in terms of intensive or less intensive rehabilitation programs. The definition of an intensive rehabilitation program, following Provinciali and Bartolini[20], is one in which the patient must be able to perform a combination of all rehabilitation activities (physical therapy, occupation therapy, speech therapy, vocational therapy and avocational therapy) for at least 3 hours a day, at least 5 days a week. This is a new measurement, and the present report is the first to use this definition to help predict the necessity of home modifications. It is easy to record but has many benefits for telling us about many things such as cognition, cardiopulmonary endurance, and muscular strength and endurance. In the present study, the rehabilitation programs were mainly conventional rehabilitation programs (range of motion exercise, strengthening exercise and ambulation programs) plus ADL training. Only patients with good physical fitness and cognition can perform intensive rehabilitation, unlike patients with a poor condition who cannot tolerate long-duration rehabilitation and usually require more passive programs.

Many studies have suggested that one-fifth to one-third of home accidents that involve older adults, including recovering stroke victims, could be prevented by home modifications and/or repairs[21]. There are many parts of a home that may require adaptation depending on the specific problem. Door levers instead of door knobs/handles operated easily by a push, handrails on both sides of staircases and outside steps, ramps for accessible entry and exit, a walk-in shower, bars in the showers, toilets and bathtubs, a hand held shower, and lever-handled faucets that are easy to turn on and off are samples of modifying the patient's living environment[22].

Environmental factors such as facilitators or obstacles should be studied in the future, as ensuring such things are as stroke-victim friendly as possible is necessary for the improvement of the stroke patients' daily life. Such studies could quite easily be carried on through health care mobile units observing the patients' normal routines.

There is insufficient evidence to determine the effects on the lives of stroke victims of interventions

to modify environmental home hazards. Further interventions to reduce hazards in the home should be evaluated by adequately designed randomized controlled trials measuring injury outcomes. The recruitment of large study samples to measure as many effects as possible, with large enough numbers to be meaningful, must be a major consideration for future trials. Further studies should explore long-term follow up of environmental factors for home modification, incidence of falls after modifications to the home, and in-depth details of home modifications.

Conclusion

The findings of the present study indicate that a low level of physical functioning (low Barthel index score) and intolerance to intensive rehabilitation are significant predictors for the necessity of home modifications in stroke victims.

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ปัจจัยที่มีผลต่อการปรับเปลี่ยนบ้านในผู้ป่วยอัมพาตครึ่งซีกจากโรคหลอดเลือดสมอง

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ภูมิหลัง: การปรับเปลี่ยนบ้านในผู้ป่วยอัมพาตครึ่งซีกจากโรคหลอดเลือดสมองมีความสำคัญเพื่อป้องกันการหกล้ม และทำให้ผู้ป่วยมีคุณภาพชีวิตที่ดี ซึ่งปัจจัยทางด้านผู้ป่วยเองเป็นปัจจัยที่น่าจะนำมาศึกษาในคนไทย

วัตถุประสงค์: เพื่อศึกษาความสัมพันธ์ด้านปัจจัยทางด้านผู้ป่วยที่มีผลต่อการปรับเปลี่ยนบ้านในผู้ป่วยอัมพาตครึ่งซีก จากโรคหลอดเลือดสมอง

รูปแบบ: การศึกษาไปข้างหน้าเชิงวิเคราะห์

วัสดุและวิธีการ: ศึกษาจากผู้ป่วยอัมพาตจากโรคหลอดเลือดสมองที่เข้ารับการรักษาในหอผู้ป่วยเวชศาสตร์ฟื้นฟู จำนวน 281 ราย จากสถาบันที่เข้าร่วมโครงการ 9 แห่ง ปัจจัยทางด้านผู้ป่วยจะถูกประเมินก่อนและหลังได้รับ โปรแกรมการฟื้นฟูสมรรถภาพ เพื่อนำมาศึกษาหาความสัมพันธ์ที่มีผลต่อการปรับเปลี่ยนบ้าน

ผลการศึกษา: ผลของการวิเคราะห์หาความสัมพันธ์ พบว่า ค่าคะแนนบาร์เทลต่ำกว่าหรือเท่ากับ 14 ทั้งก่อนและหลัง ได้รับโปรแกรมการฟื้นฟูสมรรถภาพ และผู้ป่วยที่สามารถทำการฝึกโปรแกรมการฟื้นฟูสมรรถภาพได้เฉลี่ยน้อยกว่า 3 ชั่วโมงต่อวัน มีความสัมพันธ์กับการปรับเปลี่ยนบ้าน

สรุป: ผู้ป่วยอัมพาตครึ่งซีกจากโรคหลอดเลือดสมองที่มีค่าคะแนนบาร์เทลที่ต่ำและไม่สามารถทำการฝึกโปรแกรม การฟื้นฟูสมรรถภาพแบบเข้มข้นได้ มีโอกาสสูงที่ต้องปรับเปลี่ยนบ้าน