Correlation of Fugl-Meyer Assesment Score with Barthel Index and Functional Independence Measure in Patients with Stroke

Husnul Mubarak[1], Noor Idha[1], Bayu Santoso[1]

[1]Department of Physical Medicine and Rehabilitation Faculty of Medicine Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60285, Indonesia

Abstract

Background: The prevention of stroke morbidities that is oriented to the approach of functional performance improve is expected improve the productivity of post-stroke patients. One of the tools to measure the physical performance is Fugl-Meyer Assessment (FMA) scale, while the recommended tests to measure interpedency level are Barthel Index (BI) and Functional Independence Measure (FIM).

Method: This study was conducted on 20 outpatient stroke patients in Medical Rehabilitation Installation of Dr. Soetomo General Hospital Surabaya, Indonesia. FMA, BI and FIM examination were performed in all subjects.

Results: The authors obtained the correlation coefficient value with r=0.816 and therefore a high positive correlation was found between the total score of FMA and BI, while the correlation coefficient value between the total score of FMA and FIM showed r of 0.728. Thus, the author concluded that there was a positive correlation between the total score of FMA and FIM. The sub-domains FMA-UE, FMA-LE and FMA Balance were highly correlated with BI and FIM. This implied that physical performance measured using FMA could describe the interdependency level of stroke patients in doing ADL.

Conclusion: Physical performance (based on Fugl-Meyer Assessment) was positively correlated with the interdependency level of BI and FIM of inpatient stroke patients in Medical Rehabilitation Dr. Soetomo General Hospital Surabaya.

Keywords: *Fugl-Meyer Assessment, Barthel Index, Functional Independence Measure, Stroke*

Introduction

Stroke is the main cause of death and disabilities in Indonesia and the world [1]. Elderly with hypertension have a greater risk for ischemic stroke [2]In America, the number of post-stroke population was predicted in three millions and this number has escalated twice as much of the number of post-stroke population 25 years ago. Stroke has enormous clinical, social, and economic implications and demands a significant effort [3], the prevention of stroke morbidity that is oriented in the approach of functional performance improve is expected to improve post-stroke patients' productivity. Stroke rehabilitation, if conducted comprehensively and accurately, will improve post-stroke patients' life quality and productivity [4].

Fugl-Meyer Assessment (FMA) was first introduced in 1975 as a method for evaluating post-stroke patients' physical conditions. Before FMA was published, almost all methods of motor recovery and stroke output evaluation were empiric-based or based on activities of daily living (ADL) evaluation. The experts of stroke rehabilitation consider FMA as one of the most

Corresponding Author:
Noor Idha
Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Dr. Soetomo Teaching Hospital, Universitas Airlangga, Jalan Mayjen Prof. Dr. Moestopo 47 Surabaya, Indonesia 60131,
E-mail: nooridhahandajani@gmail.com

comprehensive quantitative measuring instruments and the use of it has been recommended for stroke rehabilitation clinical observation [5].

Functional Independence Measure (FIM) was introduced in 1984 by Granger and the joint organization of representatives of medical rehabilitation institutions in the USA (United States America). This is a common instrument used for evaluating functional conditions in various types of disease which cause disabilities and indicate how much help is needed by a disabled person in performing daily activities. FIM has subsequently developed as an instrument for clinicians to evaluate rehabilitation programs and measure the success ratio of rehabilitation programs with the costs incurred [6].

In 1965, Mahoney and Barthel published a scale to measure Living/ADL. The Barthel Index initially has 10 items consisting of eating, transfer, dressing up, hygiene, bathing, toileting, walking, stair climbing, and controlling micturition and defecation. Patients with the score of 100 are considered as individuals who can eat and dress independently, walk at least one block, up and down stairs, and maintain a continuous urine/alvi. BI checks are probably the most commonly used examination in around the world to measure daily activities. Several studies have shown that this instrument has acceptable psychometric properties, including its sensitivity in measuring changes in a person's ADL, which is a major predictor of rehabilitation outcomes, as well as BI's examination results that are significantly associated with the patient's medical status [7,8].

Method

This is an observational study with cross sectional study approach. This study was conducted in Medical Rehabilitation Installation of Dr. Soetomo General Hospital from August to October 2014. There were total 20 subjects that met the inclusion criteria (patients of post-thrombotic and hemorrhagic infarction stroke in outpatient unit aged of 30-70 years with hemiparesis in dominant side, stroke occurrence in ≥3 weeks, stable cooperative cardio-respiratory functions, and able to comply with simple commands) which consisted of post-ischemic and hemorrhagic stroke outpatients. Primary data collection was conducted in all subjects. The primary parameter evaluated in the subjects were Fugl-Meyer Assessment (FMA) which was divided into 6 sub-domains: FMA-UE, FMA-LE, FMA-Sensoric, FMA-balance, FMA-ROM, and FMA-joint pain. The parameter to be compared was the subjects' level of independence by using Barthel Index questionnaire and Functional Independence Measure. All the subjects were enrolled in motor rehabilitation programs, with each subject having different program from the others. The data were analyzed using SPSS program (SPSS, Inc., Chicago, IL).

Results

Subjects general characteristics

The number of male and female subjects were 10 respectively (50%). The mean of stroke onset in the study subjects was 10.6 +7.728 months (3-36 months). The mean of the subjects age was 55.9 + 10.58 years, ranged between 30 to 73 years. The majority of the subjects' dominance were right-handed. In accordance with the inclusion criteria, i.e. hemiplegia in the dominant side, most subjects (17 subjects or 85%) had right hemiparesis. The 16 subjects (80%) were generally infarction stroke patients (Table 1).

Correlation between FMA-total score and Barthel Index score

A significant correlation was found between FMA-total score and Barthel Index score with r=0.816 using Pearson's correlation test with p value of <0.05. The graphic in XY curve also showed a correlation between the two examination instruments, in which the higher the FMA-total score was, the higher the Barthel Index score would be.

Figure 3 showed the curve of the subjects' FMA-total and Barthel Index score distribution. The authors conducted Pearson's correlation analysis in each sub-domain of FMA and found that in the sub-domains FMA-UE, FMA-LE and FMA-Balance, significant correlations were found with Barthel Index score with the correlation coefficient of 0.739, 0.820 and 0.800 respectively. Meanwhile in the sub-domains FMA-Joint Pain, FMA-Sensory and FMA-ROM did not have any significant correlation with Barthel Index score.

Correlation between FMA-total score and Functional Independence Measure score

A significant correlation was found between FMA-total score and Functional Independence Measure (FMI) score with correlation coefficient of r=0.728 by using Pearson's correlation test with p >0.05.

Pearson's correlation analysis in each sub-domain of FMA showed a correlation with FIM score with r=0.747 in the sub-domain FMA-UE, r=0.719 in the sub-domain FMA-LE and r=0.694 in the sub-domain FMA-balance. Similar to FMA and Barthel Index comparison, the sub-domains FMA-sensory, FMA-joint pain and FMA-ROM did not show any significant correlation with FIM score.

Table 1. Subjects' characteristics

Characteristics	**Total**
Gender	
Laki-laki Perempuan	10 (50%) 10 (50%)
Age (Mean+SD) Range	55.9 + 10.58 years (30–73)
Hemiparese Side	
Right Left	17 subjects (85%) 3 subjects (15%)
Stroke Type	
Infarction Hemorrhagic	16 subjects (80%) 4 subjects (20%)
Stroke Onset (Mean+SD) Range	10.6 + 7.95 months (3–36)
FMA-UE (Mean+SD)	43.8 + 18.38 points (4 – 66)
FMA-LE (Mean+SD)	22.55 + 7.69 points (6 – 34)
FMA-Sensory (Mean+SD)	19.9 + 3.21 points (12 – 24)
FMA-Balance (Mean+SD)	8.25 + 2.82 points (2 – 13)
FMA-Joint pain (Mean+SD)	35.1 + 6.67 points (22 – 42)
FMA-ROM (Mean+SD)	38.15 + 5.15 points (25 – 42)
FMA-Total (Mean+SD)	167.5+ 33.73 points (110 – 220)
Barthel Index (Mean+SD)	80.75 + 16.56 points (40 – 100)
FIM (Mean+SD)	101.45 + 18.38 points (60 – 126)

*FMA = Fugl Meyer Assessment; FMA-UE: Fugl Meyer Assessment-upper extremity; FMA-LE: Fugl Meyer Assessment – Lower Extremity; FMA-ROM: Fugl Meyer Assessment- Range of Motion; FIM: Functional Independence Measure

Table 2. Correlation coefficient of FMA-total and FMA sub-domains toward Barthel Index scores using Pearson's correlation (significant if p <0.05)

FMA Sub-Domains	Correlation Coefficient (r)	p Value (Pearson's correlation) p < 0.05 significant
FMA – Upper Extremity	0.739	0.000*
FMA – Lower Extremity	0.820	0.000*
FMA – Balance	0.800	0.001*
FMA – Sensorik	0.422	0.064
FMA – Joint pain	0.378	0.100
FMA – Range of Motion	0.291	0.212
FMA – Total	0.816	0.000*

Table 3. Correlation coefficient of FMA-total and FMA sub-domains towards FIM scores using Pearson's correlation (significant if p <0.05)

FMA Sub-Domains	Correlation Coefficient (r)	p Value (Pearson's) Pp< 0.05 significant
FMA – Upper Extremity	0.728	0.000*
FMA – Lower Extremity	0.747	0.000*
FMA – Balance	0.694	0.001*
FMA – Sensorik	0.267	0.256
FMA – Joint pain	0.283	0.226
FMA – Range of Motion	0.116	0.625
FMA – Total	0.728	0.000*

Discussion

The result of this study showed that most subjects (10 subjects or 50%) had significant motor impairment, while the other subjects had slight and severe impairment with 6 (30%) and 4 (20%) subjects respectively. A study by Duncan in 1992 with the subjects consisted of 104 stroke patients reported that 37 subjects (35.6%) had slight motor impairment, 2 subjects (21.2%) had moderate motor impairment, 13 subjects (12.5%) had significant motor impairment and 32 subjects (30.8%) had severe motor impairment [9].

In this study, the obtained mean of FMA-UE was 43.08±18.38 (4-66), while the mean of FMA-LE score was 22.55±7.69 (6-34). The mean of FMA-sensory score was 19.9±3.21 (12-24). This was in line with the results of a study by Sullivan et al. conducted in 15 stroke patients in which the obtained mean of FMA-UE was 30.40 (5-63) and FMA-LE motor score mean was 23.10 (8-33), whereas the mean of FMA-sensory total score was 18.70 (2-24). This implied that the mean of FMA-LE motor score was higher than that of FMA-UE motor score if reviewed from each instruction item's score and sensory total score which were not much different from

the results from Sullivan et al. [10].

The mean of FMA-balance score was 8.25±2.82 with the lowest score being 2 and the highest score 14. The score of FMA-balance was lower than that in the study by de Oliveira et al. in Physiotherapy and Occupational Therapy Ambulatory of the University Hospital-UNICAMP, Brazil, in which the obtained FMA-balance of the 20 stroke patients was 10.80±1.24 [7].

The mean value of FMA-Total in this study was 167.5 + 33.73 (110-220). The mean FMA-total value was consistent with research conducted by de Oliveira , i.e. [6] 170.50±31.91. The mean FMA-total in this study indicated that the functional state of the subjects was in a phase where there a controlled movement occurred outside of the synergistic pattern of the limbs and the spasticity level that has begun to decline [7].

Barthel Index score mean obtained was 80.75±16.56 points and ranged between 40-100 points. This was slightly different from the results obtained by de Oliveira et al in which the authors also evaluate the correlation between FMA and Barthel Index. The mean of Barthel Index score in that study was 90.75±5.45 [7].

The mean of the subjects' FIM score was 101.45±18.38 points and ranged from between 60-126 points. This indicated the subjects' state where they could perform daily activities although the caregivers' supervision was still required in each FIM measurement. The mean of FIM score here was higher compared to the results from Ravaud J.F. et al who tested the FIM constructive validity as a rehabilitation instrument. The FIM score mean in that study was 80.17±27.06 [11].

This study's results suggested that FMA-total score was significantly correlated with Barthel Index with the correlation coefficient of r=0.816. The correlation coefficient indicated a strong correlation between FMA score and BI score. The results of this study showed a higher correlation coefficient value compared to that of the study conducted by Oliveira et al. who obtained a statistically significant correlation coefficient ($P < 0.05$) of r = 0,597. This indicated that the level of physical performance measured based on the FMA value affected a person's level of independence in performing daily activities (ADL/Activity Daily Living). The high correlation coefficient in the study implied that FMA score could be used as a reference to measure a stroke patient's independence level [7].

The results of this study also indicate that the sub-domains FMA-UE, FMA-LE and FAM-balance had statistically strong correlation with Barthel Index score. This suggested that motor function recovery (AGA and AGB) in stroke patients along with the post-stroke balance level were correlated in improving a stroke patient's independence. This was also similar to the study by de Oliveira where a significant correlation was found between the sub-domain motor total and Barthel Index score with r=0.597. In addition, Ferrucci et al. also reported a quite statistically significant correlation between FMA score and Barthel Index score.

AGA was known to have a bigger role in self-care while AGB affected mobility. However, the correlation coefficient in this study was higher in FMA-LE than in FMA-UE toward Barthel Index. The authors assumed that this was because in performing self-care activities, the subjects have done substitutions in the non-dominant arm that did not impacted by hemiparese. This was stated by Olsen et al. who assumed that a compensatory mechanism has occurred as a strategy in functional performance. The mobility components were considered as the components causing FMA-LE and FMA-balance to have a statistically significant correlation with Barthel Index. Correlation between balane and functional performance has often been documented in hemiparese patients, in which a posture impairment was found that was related to standing and sitting balance and this would lead to impairments in functional performance related to mobilization [7,12].

Other results showed that FMA total score had statistically correlation with FIM score with r=0.728. FIM was the more current instrument and had a rapid popularity increase. Aside of measuring ADL, this examination also had social and communication cognitive items. This instrument was considered more quantitative compared to Bathel Index since the score of each FIM item was ranged between 1-7 and thus the score of each item would be more specific.

A lot number of evidences from several validation studies confirmed that the FMA score could represent the independence level or disability level of stroke patients. In this study, the scores were found in FMA-UE, FMA-LE and FMA-balance that were significantly correlated with FIM score, with correlation coefficient of 0.728, 0,747 and 0.694 respectively. All FMA components were highly correlated with FIM. This was understandable since FIM items required functional

motor strength and balance for independent functional performance. However, the correlation coefficient of FMA-BI was higher than that of FMA-FIM. It was caused by the cognitive and communication components in FIM were not empirically correlated with motor performance or balance. However, cognitive and communication components had lower score proportion compared to self-care, sphincter control, mobility and locomosi in which then correlation between FMA-total and FIM remained found despite the correlation coefficient being lower than that of FMA-total and BI.

Conclusion

A high positive correlation was found between functional performances measured using Fugl-Meyer Assessment and interdependency levels in performing daily activities measured using Functional Independent Measure (FIM) score in stroke patients with dominant-side hemiparese undergoing the rehabilitation programs in Medical Rehabilitation Hospital.

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