Relationship between risk factors and activities of daily living using modified Shah Barthel Index in stroke patients

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Abstract. Hypertension and diabetes mellitus are the most common risk factors of stroke. The study aimed to determine the relationship between hypertension and diabetes mellitus risk factors and dependence on assistance with activities of daily living in chronic stroke patients. The study used an analytical observational cross-sectional design. The study’s sample included 44 stroke patients selected using the quota sampling method. The relationship between the variables was analyzed using the bivariate chi-squared test and multivariate logistic regression. Based on the chi-squared test, the relationship between the Modified Shah Barthel Index (MSBI) score and hypertension and diabetes mellitus as stroke risk factors, were p = 0.122 and p = 0.002, respectively. The logistic regression results suggest that hypertension and diabetes mellitus are stroke risk factors related to the MSBI score: p = 0.076 (OR 4.076; CI 95% 0.861-19.297) and p = 0.007 (OR 22.690; CI 95% 2.332-220.722), respectively. Diabetes mellitus is the most prominent risk factor of severe dependency on assistance with activities of daily living in chronic stroke patients.

1. Introduction

Stroke is a type of blood vessel disease in the brain that can lead to death. According to the World Health Organization (WHO), stroke is characterized by symptoms of focal or multifocal lesions of the brain that occur suddenly within a timeframe of more than 24 hours, which can lead to death [1,2]. Stroke is a degenerative disease that generally appears in geriatric patients with an average age of 65.1. Stroke can be caused by subarachnoid hemorrhage (7%), intracerebral hemorrhage (12%), and cerebral infarction (73%); its etiology can also be unknown (8%) [3,4]. Ischemic stroke is caused by narrowing of the blood vessels and patching of the thrombocytes associated with coronary artery disease, which triggers blood clots and brain damage. Several risk factors are associated with strokes, some of which can be modified and some of which cannot be modified. Age, sex, and family history are some examples of unmodifiable risk factors. The risk factors that can be modified include blood pressure associated with hypertension, blood sugar levels associated with diabetes mellitus, hyperlipidemia, heart disease, blood disorders, and obesity. Hypertension and diabetes are two risk
factors associated with the largest incidence of stroke. The prevalence of stroke-related hypertension is greater than the prevalence of stroke-related diabetes mellitus [5].

Hypertension can cause strokes through a variety of mechanisms [6]. Hypertension is a condition in which high intraluminal pressure affects changes in the consistency of the endothelium and smooth muscle in the intracerebral artery [7]. Increased endothelial pressure can increase blood brain barrier permeability and cause focal or multifocal edema ultimately resulting in the formation of lesions in the brain [7]. The formation of cerebral lesions has an impact on the onset of stroke. Endothelial damage due to hypertension and changes in endothelial consistency in the blood vessels in the brain cause ischemic lesions [8]. Functional smooth muscle changes in the blood vessels are common due to hypertension, but they may result from an individual’s age. Abnormal blood vessel muscle changes become a predisposing risk factor for intracerebral bleeding [9]. In addition, hypertension accelerates the occurrence of arteriosclerosis [9]. This study uses the American Heart Association and Joint National Committee 8 (JNC 8) classification of hypertension [10].

Diabetes mellitus is a metabolic syndrome that causes abnormalities of glucose metabolism, and it is associated with hyperglycemia [11]. Diabetes is also a risk factor for stroke, as evidenced by its correlation with increased mortality due to stroke [12]. The relationship between metabolic syndrome and the occurrence of stroke is unique; thus, many researchers have studied it. Previous research has not found a satisfactory correlation between diabetes mellitus and stroke. However, recent research conducted by previous study stated that diabetes mellitus is associated with coronary heart disease (CHD). This is evidenced by the number of deaths from CHD in diabetic patients, which has been shown to be as high as 40–50% [11,12]. Research by the Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS) reported that diabetes mellitus patients’ risk of ischemic stroke was much greater than that of nondiabetic patients in each age group. The diabetic patients with the highest risk of stroke are in the 45 to 54 age group (relative risk [RR] 5.3). In African-Americans, the risk of stroke in diabetic patients occurs in the 35 to 44 age group (RR 5.3) [11,12].

The pathophysiology responsible for the onset of stroke in patients with diabetes mellitus is the mechanism of insulin resistance due to metabolic failure [11]. Insulin resistance is a pathological condition in which cells are unable to respond to the presence of insulin that occurs in the body due to normal physiology [13]. Physiologically, insulin plays a role in converting glucose to glycogen [14]. A study conducted by Atherosclerosis Risk in Communities (ARIC) reported that the increase in the RR in patients with insulin resistance was 1.19 for every 50 pmol/l insulin increase in the blood circulation. In atherosclerosis, insulin triggers the proliferation of smooth muscle in arterial tissue and incorporates glucose molecules into the lipids. Insulin resistance affects high levels of glucose in the blood, which is known as hyperglycemia. Hyperglycemia causes a hyperosmolar or general condition called Hyperglycemic Hyperosmolar Syndrome (HHS). HSS generally occurs in patients with type II diabetes [11,12]. Reliable measurement of dependency on assistance with activities of daily living (ADL) is an important component of the rehabilitation process, and it has clinical research value [15]. Systematic measurement aims to provide an objective and quantitative description of a patient’s motor skills. It is used to describe and communicate a patient’s self-care and mobility capabilities, monitor clinical status changes, assist in medical care decisions, evaluate the effectiveness of treatment, and prevent further disability.16 The Modified Shah Barthel Index (MSBI) is a modification of the Barthel Index, which was developed by Mahoney and Barthel and modified by Shah, Vanclay, and Cooper in 1998 [16]. MSBI is one of the most widely used measurement scales. Similar to the Barthel Index, MSBI assesses 10 components of activity.

MSBI aims at improving the lack of sensitivity of the Barthel Index. Thus, the key component of the MSBI is the addition of information about the number of assistants a patient needs in order to perform each of the 10 assessment components [16]. MSBI delineates assistance into four categories: totally requiring assistance, capable of performing tasks alone, but unsafe to do so, requiring moderate assistance, and requiring minimal assistance [16]. In addition to determining the amount of assistance required, MSBI also evaluates a patient’s motor skills in terms of the physical and supervisory assistance that is needed [16]. With these changes, the MSBI scale is considered to increase trust,
minimize subjectivity in judgment, and identify a correlation between the components, without removing the scores obtained from the previous Barthel Index. Moreover, it does not take a long time to conduct the MSBI, so it is more efficient to use in everyday practice. However, use of the MSBI assessment is not yet able to increase the sensitivity of the Barthel Index scale [16,17].

2. Materials and Methods
The present study used a cross-sectional research design. This design was chosen because this study aimed to determine the value of using the MSBI score to determine chronic phase stroke patients’ risk of hypertension or diabetes mellitus, and its correlation to dependence on assistance with ADL that are instantaneous without any specific intervention or that are monitored in a specific timeframe. It used secondary data from the MSBI and supporting data from the medical records of the research subjects. The secondary data were obtained using the MSBI to assess the ability of chronic phase stroke patients, who were undergoing outpatient care, to participate in ADLs. Data from a total of 44 study subjects were obtained.

The independent variable was the risk factor of stroke (hypertension or diabetes mellitus) and the dependent variable was the research subjects’ MSBI scores using the chi-squared test. If not, Fischer’s exact test was used. The results were statistically significant when p < 0.05 with 95% confidence interval (CI). Multivariate logistic regression analysis was conducted if the chi-squared test results showed a statistical significance of p < 0.25. Descriptive data for the categorical variables were generated in the form of proportions and CI values. Data were processed using the SPSS V.22.

3. Results and Discussion
3.1 Results
Characteristics of the Research Subjects
Table 1 showed the characteristics of the research subject. Table 2 presents information about the distribution of systolic blood pressure in the patient groups, with and without hypertension, based on risk factors for age, sex, diagnosis of stroke, and hemiparesis side. Of the group without hypertension risk factors, 9 patients were in the productive age range (17–60 years), 13 were males, 12 were

| Variable                          | Quantity (n) | Percentage (%) |
|-----------------------------------|--------------|----------------|
| Age (years)                       |              |                |
| 40–50                             | 8            | 18.2           |
| 51–60                             | 17           | 38.6           |
| 61–70                             | 13           | 29.5           |
| >71                               | 6            | 13.6           |
| Sex                               |              |                |
| Male                              | 30           | 68.2           |
| Female                            | 14           | 31.8           |
| Risk Factors                      |              |                |
| Hypertension (≥140/90 mmHg)       | 27           | 61.3           |
| Uncontrolled diabetes mellitus    | 15           | 34.1           |
| Blood Pressure                    |              |                |
| Normal                            |              |                |
| Prehypertension                   | 8            | 18.2           |
| Hypertension Stage I              | 9            | 20.5           |
| Hypertension Stage II             | 25           | 56.8           |
| Hemiparesis side                  | 2            | 4.5            |
| Dextra                            | 17           | 38.6           |
| Sinistra                          | 21           | 47.7           |
| Duplex                            | 6            | 13.6           |
| Stroke                            |              |                |
| Ischemic stroke                   | 32           | 72.7           |
| Hemorrhagic stroke                | 8            | 18.2           |
| Ischemic and hemorrhagic stroke   | 4            | 9.1            |
diagnosed with ischemic stroke, and 9 had left-sided hemiparesis. Of the patients with hypertension risk factors, 16 were in the productive age range, 17 were males, 20 were diagnosed with ischemic stroke, 12 had left-sided hemiparesis, and 12 had right-sided hemiparesis.

**Distribution of Systolic Blood Pressure in the Research Subjects**

**Table 2. Distribution of the hypertension risk factors in the research subjects**

|            | Without hypertension risk factors | With hypertension risk factors | Total |
|------------|-----------------------------------|--------------------------------|-------|
|            | n   | %     | n   | %     |       |
| Age        |      |       |      |       |       |
| Productive | 9    | 20.5  | 16   | 36.4  | 24    |
| Geriatric  | 8    | 18.2  | 11   | 15.0  | 20    |
| Sex        |      |       |      |       |       |
| Male       | 13   | 29.5  | 17   | 38.6  | 30    |
| Female     | 4    | 9.1   | 10   | 22.7  | 14    |
| Stroke Diagnosis |      |       |      |       |       |
| Ischemic   | 12   | 27.3  | 20   | 45.4  | 32    |
| Hemorrhagic| 3    | 6.8   | 5    | 11.4  | 8     |
| Ischemic and hemorrhagic | 2 | 4.5 | 2 | 4.5 | 4 |
| Hemiparesis side |      |       |      |       |       |
| Right      | 5    | 11.4  | 12   | 27.3  | 17    |
| Left       | 9    | 20.5  | 12   | 27.3  | 21    |
| Both       | 3    | 6.8   | 3    | 6.8   | 6     |
| Total      | 17   | 38.6  | 27   | 61.4  | 44    |

**MSBI Scores in the Groups with Hypertension and Diabetes Mellitus Risk Factors**

This study used the MSBI measurement scale that was ordinal categorical. The information in Figure 1 and Figure 2 presents the qualitative and quantitative findings of the MSBI assessment results. In this study, the researchers combined the five categories of MSBI into two broad categories of light dependence and heavy dependence. The basis of this division was an MSBI score of 60, which was considered a transition point from heavy dependence to light dependence, or vice versa [17].

![Figure 1. MSBI scores for the hypertension risk factor group](image)
The information presented in Figure 1 and Figure 2 shows a comparison of need for assistance with ADLs based on the MSBI results for the hypertension risk factor and diabetes mellitus risk factor groups that had a total dependence (minimum) on assistance with ADLs and those that required no assistance with ADLs (maximum). The information in Figure 1 shows that patients with risk factors for hypertension have a significant total dependence on assistance with ADLs associated with bowels, bladder, bathing, dressing, grooming, and feeding. The information in Figure 2 shows that patients with risk factors for diabetes mellitus were dependent on assistance with ADLs for virtually all of the MSBI assessment items.

**Frequency of the Distribution History of the Diabetes Mellitus Research Subjects**

Table 3 presents the distribution of the groups of patients with and without risk factors for diabetes mellitus based on age, sex, diagnosis of stroke, and hemiparesis side. Of the group without risk factors for diabetes mellitus, 17 patients were in the productive age range, 21 were males, 18 were diagnosed with ischemic stroke, and 18 suffered left-sided hemiparesis. In the group with risk factors for diabetes mellitus, 8 patients were in the productive age range, 9 were males, 14 were diagnosed with ischemic stroke, and 8 had right-sided hemiparesis.

**Table 3. Distribution of the diabetes mellitus respondents’ risk based on age, sex, stroke diagnosis, and hemiparesis side**

|                           | Without diabetes mellitus risk factors | With diabetes mellitus risk factors | Total |
|---------------------------|----------------------------------------|------------------------------------|-------|
|                           | n   | %    | n   | %    |       |
| **Age**                  |     |      |     |      |       |
| Productive               | 17  | 38.6 | 8   | 18.2 | 25    |
| Geriatric                | 12  | 27.3 | 7   | 15.9 | 19    |
| **Sex**                  |     |      |     |      |       |
| Male                     | 21  | 47.7 | 9   | 20.5 | 30    |
| Female                   | 8   | 18.2 | 6   | 13.6 | 14    |
| **Stroke Diagnosis**     |     |      |     |      |       |
| Ischemic                 | 18  | 40.9 | 14  | 28.8 | 32    |
| Hemorrhagic              | 8   | 18.2 | 0   | 0.0  | 8     |
| Ischemic and hemorrhagic | 3   | 6.8  | 1   | 2.3  | 4     |
| **Hemiparesis side**     |     |      |     |      |       |
| Right                    | 9   | 20.5 | 8   | 18.2 | 17    |
| Left                     | 18  | 40.9 | 3   | 6.8  | 21    |
| Both                     | 2   | 4.5  | 4   | 9.1  | 6     |
| **Total**                | 17  | 38.6 | 27  | 61.4 | 44    |
Table 4. Interpretation of the statistical and clinical results of stroke risk factors based on the MSBI score

| Case                        | Significance Limit | Minimal size effect (RR) | OR (CI 95%)                      | Planning Analysis Result | Interpretation       |
|-----------------------------|-------------------|--------------------------|---------------------------------|--------------------------|----------------------|
| Hypertension risk factor    | 5%                | 0.699                    | 0.122*                          | 2.672 (0.757–9.426)      | Not Meaningful       |
| DM risk factor              | 5%                | 0.480                    | 0.002*                          | 17.321 (1.994–148.921)   | Meaningful           |

Bivariate Analysis Interpretation with Proportional Comparison of the Risk Factors
Based on the p value obtained from the bivariate test results, it can be concluded that the hypertension stroke risk factor p value was >0.05, so it was not statistically significant, while the diabetes mellitus risk factor p value was <0.05, so it was significant statistically. To determine the clinical significance of the hypertensive risk factors associated with severe dependence on assistance with ADLs, the minimum size effect of 2.672 was compared with the minimum expected size effect of 0.699. To determine the clinical significance of the association between diabetes mellitus risk factors and severe dependence on assistance with ADLs, the effect of the minimum size of 17.321 was compared with the minimum expected size of 0.480. When the minimum effect size value of the study was evaluated, both stroke risk factors were greater than the smallest limit of the expected minimum effect size, which demonstrates that both hypertension and diabetes mellitus are clinically significantly associated with the emergence of severe dependence on assistance with ADLs in chronic stroke patients.

Logistic Regression of the Hypertension and Diabetes Mellitus Risk Factors for Stroke based on the MSBI Scores
To determine the factors that could be predictors of heavy dependence on motor output in performing ADLs for chronic phase stroke patients, multivariate analysis was performed. Toward that end, a logistic regression test that can be used in cross-sectional studies was conducted. The logistic regression test was selected due to the dependent variables as identified from the MSBI, which represented a categorical dichotomy. Before performing the logistic regression test, the study’s hypothesis was tested using chi-squared bivariate analysis.

The results of the bivariate analysis of the hypertension and diabetes mellitus risk factors are presented in Table 5. To analyze hypertension as a risk factor for stroke, the group without hypertension risk factors was compared to the group with hypertension risk factors. Moreover, the group with diabetes mellitus risk factors was compared to the group without diabetes mellitus risk factors. The result for both the hypertension risk factor (p value = 0.219 [correction continuity value]) and the diabetes mellitus risk factor (p = 0.005 [correction continuity value]) fulfilled the requirement for the logistic regression test (p-value < 0.25).

Table 5. Bivariate Chi-squared test results for the stroke risk factors in relation to the MSBI score

|                   | Light Dependence | Heavy Dependence | p-value | OR (CI 95%) | Min | Max |
|-------------------|------------------|------------------|---------|-------------|-----|-----|
| Hypertension risk factor | No   | 9 20.5 | 8 18.2 | 0.122* | 2.672 | 0.757 | 9.426 |
|                    | Yes  | 8 18.2 | 19 43.2 | 0.219** | 0.757 | 9.426 |
| Diabetes mellitus risk factor | No | 16 36.4 | 13 29.5 | 0.002* | 17.231 | 1.994 | 148.921 |
|                    | Yes  | 1 4.5  | 14 31.8 | 0.005** | 1.994 | 148.921 |
| Total              | 21 47.7 | 23 52.3 |         |             |     |     |

*Fischer’s exact test results
**Correction continuity score
After the logistic regression test, it was found that the hypertension and diabetes mellitus risk factors were the variables that influence heavy dependence on motor output in performing ADLs for chronic phase stroke patients. Table 4: 24 presents the results of the logistic regression test; the strength of the relationship of each variable can be seen from the value of the odds ratio (OR) [EXP1] and the strength of the relationship between the hypertension risk factor (OR = 4.076) and the diabetes mellitus risk factor (OR = 22.332). The equation obtained from the logistic regression test is:

\[ y = -1.17 + 1.405 \text{(hypertension risk factor)} + 3.122 \text{(diabetes mellitus risk factor)} \]

The equation is used to predict whether chronic stroke patients will suffer heavy dependence on assistance with ADLs, post-stroke. To simplify this, the researchers used coding based on the coefficient value of the logistic regression test value so that 1 and 2 were used for the hypertension risk factor and 1 and 2 were used for the diabetes mellitus risk factor. Later, the coding was substituted into the equation to obtain the possibility of a stroke patient becoming dependent on assistance with ADLs.

### Table 6. Multivariate test results: Logistic regression for the stroke risk factors in relation to the MSVI score

| Coefficient | β    | p-value | OR    | CI 95%   |
|-------------|------|---------|-------|----------|
| Hypertension| 1.405| 0.076   | 4.076 | 0.861-19.297 |
| Diabetes Mellitus | 3.122 | 0.007 | 22.69 | 2.332-220.722 |
| Constants   | -1.117| 0.095   | 0.327 |          |

Two methods were used to assess the quality of the equations: looking at the calibration value of the Hosmer and Lemeshow test and determining the discrimination parameters using area under the curve (AUC). Based on the Hosmer and Lemeshow test, \( p = 0.623 \); this means that the equation has good calibration. The receiver operating characteristic (ROC) curve model analysis results are shown in Graph 3. Based on the discrimination value, the value of AUC was 80.1% with 95% CI, ranging between 67.3% and 92.9%. Thus, the result was strongly clinically.
3.2 Discussion

Characteristics of the Research Subjects

The research subjects were chronic phase stroke patients with risk factors for hypertension and diabetes mellitus at Cipto Mangunkusumo Hospital. The inclusion criteria for patients with hypertensive stroke risk factors in the study were based on JNC 8 classifications: hypertension stage I or stage II (systolic blood pressure $\geq$140/90 mmHg) with or without antihypertensive drug intervention. Based on the results reported in Riskesdas 2013, the prevalence rate for strokes increased from 8.7 per 1000 in 2007 to 12.1 per 1000 in 2013 in Indonesia [18]. The prevalence of diabetes mellitus also increased from 1.1% in 2007 to 2.1% in 2013 [18]. In contrast, the prevalence of hypertension decreased from 31.7% in 2007 to 25.8% in 2013 [18].

In general, the research subjects in the present study were chronic phase stroke patients undergoing rehabilitation at the RSCM Medical Rehabilitation Department. Most of the patients ranged in age from 51 to 60 as many as 17 patients (38.65%) and 30 (68.2%) were male. Kusuma et al. [19] conducted a study on the profile of stroke disease in Indonesia and reported similar age characteristics for their research subjects (average age of 58.8). In a study conducted by Dian [12], the majority of the subjects (67%) were male. Thus, it can be concluded that the characteristics of the research subjects used in the present study were sufficient to describe the condition of stroke patients in Indonesia.

In the present study, 27 (61.4%) of the research subjects had hypertension risk factors; 25 patients were classified as having stage I hypertension and 2 patients were classified as having stage II hypertension. When distribution of the study subjects with hypertensive risk factors was based on age, 17 patients (38.6%) were classified into the group without hypertensive risk factors; of those, 9 were in the productive age group (17–60 years), and 8 were in the geriatric age group (>60 years). Of the remaining 27 patients (61.4%) with hypertension risk factors, 16 were in the productive age group (17–60 years) and 11 were in the geriatric age group (>60 years).

When the distribution of research subjects with hypertension risk factors was categorized by sex, 17 patients (38.6%) were in the group without hypertension risk factors (13 males and 4 females). Of the remaining 27 patients (61.4%) with hypertension risk factors, 17 were male and 10 were female. In terms of the hemiparesis side, 17 patients (38.6%) were in the group without hypertension risk factors; of those, 5 patients had right-sided hemiparesis, 9 had left-sided hemiparesis, and 3 had weakness on both sides. Of the remaining 27 patients (61.4%) with hypertension risk factors, 12 had right-sided hemiparesis, 12 had left-sided hemiparesis, and 3 had weakness on both sides.

Of the 44 patients that participated in this study, 15 (34.1%) had risk factors for diabetes mellitus. When the distribution of research subjects with diabetes mellitus risk factors was associated with age, 29 patients (65.9%) were in the group without diabetes risk factors; of these 17 patients were in the productive age category (17–60 years) and 12 were in the geriatric age group (>60 years). Of the remaining 15 patients (34.1%) with diabetes mellitus risk factors, 8 were in the productive age category (17–60 years) and 7 were in the geriatric age group (>60 years). When the diabetes risk factors were associated with gender, 29 patients (65.9%) were in the group without diabetes mellitus risk factors (21 males and 8 females). Of the remaining 15 patients (34.1%) with diabetes mellitus risk factors, 9 were male and 6 were female. When associated with hemiparesis side, 29 patients (65.9%) were in the group without diabetes risk factors; of those 9 had right-sided hemiparesis, 18 had left-sided hemiparesis, and 2 had weakness on both sides. Of the remaining 15 patients (34.1%) with

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Table 7. Interpretation of the ROC logistic regression stroke risk factor results related to heavy dependence on assistance with ADLs

| Area | Minimum | Maximum |
|------|---------|---------|
| 0.801 | 0.673   | 0.929   |
diabetes mellitus risk factors, 8 had right-sided hemiparesis, 3 had left-sided hemiparesis, and 3 had weakness on both sides.

### Types of Strokes in the Research Subjects

The majority of the study subjects (32 patients [72.7%]), were diagnosed with ischemic stroke, followed by hemorrhagic stroke (8 patients [18.2%]), and a mixture of (ischemic and hemorrhagic stroke (4 patients [9.1%]). This study did not distinguish between first time stroke patients and patients who had experienced more than one stroke. In this study, the distribution of stroke diagnosis was similar to that reported by Nastiti [2] in which 85% of the patients were diagnosed with ischemic stroke and 15% of patients were diagnosed with hemorrhagic stroke. A diagnosis of ischemic stroke and hemorrhagic stroke should be determined to provide appropriate management; this is related to the differences in the stroke related risk factors previously mentioned in this present study. The proportion of stroke type in the present study is the same as that reported by Kusuma et al. [19]. In that study, ischemic stroke (42.9%) was most frequently diagnosed, followed by hemorrhagic stroke (19.9%) (PSA 1.4% and PIS 18.5%), and undiagnosed type of stroke (37.2%) [19].

Ischemic stroke results from two dominant pathogenic mechanisms: cerebral embolism and cerebral thrombosis. Cerebral embolism and cerebral thrombosis indicate carotid artery occlusion or occlusion of vertebral or other arteries caused by atherosclerosis. In thrombotic ischemic stroke, the major source of the embolism originates either from the heart, after atrial fibrillation or myocardial infarction, or from other blood vessels [20]. Hemorrhagic stroke includes intra-cerebral bleeding and sub-Arachnoid bleeding, and subdural hematoma. Hemorrhagic stroke is associated with a ruptured aneurysm, causing damage to the brain parenchyma; it can also be caused by a contusion leading to subdural hematoma. The main mechanisms underlying the three causes of hemorrhagic stroke are: intracerebral vascular damage due to chronic hypertension, iatrogenic anticoagulation, cerebral amyloidosis, bleeding diathesis, and cocaine abuse. In general, intracerebral hemorrhage occurs in people between the ages of 50 and 75. The difference in the location and size of the hemorrhagic lesions contributes to the manifestation and prognosis [20].

A retrospective study conducted by Bilic et al. [21] concluded that there are some differences in risk factors for ischemic and hemorrhagic strokes. In that study, 47.9% of the research subjects in the hemorrhagic stroke group were female and 52.1% were male. In the ischemic stroke group, 48.9% of the subjects were female and 51.1% were male. In addition, the patients with ischemic stroke were found to be older than the patients with hemorrhagic stroke; they also had a higher prevalence of hypertension and atherosclerotic disease [21]. The same result was also obtained in another study which reported that the risk factors for the ischemic stroke group included diabetes, atrial fibrillation, previous myocardial infarction, and atrial intermittent claudication. However, that study revealed no difference between sex, age, and prevalence of hypertension in hemorrhagic stroke and ischemic stroke risk factor groups. When associated with both postoperative outcomes and post-stroke strains, the study showed that the risk of hemorrhagic stroke was higher risk than the risk of ischemic stroke [21,22].

In the present research study, 4 patients (9.1%) had a diagnosis of mixed ischemic and hemorrhagic stroke, or they had either not yet been diagnosed with a specific type of stroke or they had experienced an ischemic stroke followed by a hemorrhagic stroke Ardia et al. [23] reported that an ischemic stroke caused by embolism (cardioemboli) has to be managed with anticoagulant quickly and accurately, otherwise it will increase the risk of exacerbation in the form of bleeding in areas that have ischemic infarction. To prevent this from happening, some studies have suggested the use of intravenous heparin anticoagulation, which claims to be able to reduce the clinical and statistical risk of re-stroke and mortality.

Based on the results obtained from the present study, 20 patients in the group with hypertension risk factors and 12 patients in the group without hypertension risk factors were diagnosed with ischemic stroke. This proportion was much greater than the group with diabetes mellitus risk factors in which only 14 patients were diagnosed with ischemic stroke. At a glance, it was assumed that
hypertension was more predominant in causing ischemic stroke, but if the proportion was assessed holistically, only 20 out of 27 (74.1%) of the patients with hypertensive risk factors had ischemic stroke, whereas 14 of the 15 patients (93.3%) in the group with diabetes mellitus risk factors were diagnosed with ischemic stroke.

**The MSBI Scores of the Research Subjects**

The MSBI assessment aimed to measure the neuromuscular and musculoskeletal abilities of chronic phase stroke patients to perform ADLs. There were 10 ADL assessment items: feeding, bathing, dressing, grooming, bowels, bladder, toilet use, transfer from a chair, ambulation, and climbing stairs. In the present study, the MSBI evaluation was conducted by residents and medical rehabilitation specialists at the Medical Rehabilitation Department Cipto Mangunkusumo Hospital. Based on the consensus of Medical Rehabilitation Medical International, the MSBI assessment was conducted over the course of 2 to 25 minutes, either by direct patient reporting or by direct clinical observation [24].

No special requirements are need for MSBI appraisers (all types of healthcare workers, ranging from nurses to general practitioners) to conduct an MSBI assessment [24]. Collin et al. noted that the direct patient reporting method decreases the sensitivity of the results and confuses patients [25,26]. Therefore, to minimize this in the present study, the MSBI was conducted by trained physicians using direct observation methods. Previous research conducted a study on the comparative method of MSBI assessment; they found that both direct reporting from patients and a performance-based direct assessment by a healthcare worker were effective methods for administering the MSBI. However, the two methods provided different information about the patients’ functional capabilities; direct reporting was useful in older patients whereas performance assessments provided more specific and sensitive results than direct reporting. However, in practice both methods can be used in the assessment of MSBI [27].

In the present study, the MSBI assessment to determine the study subjects’ dependence on assistance with ADLs post-stroke showed that 27 patients (61.4%) received scores ranging from 0 to 60 and were categorized as having a heavy dependence on assistance, while 17 patients (38.6%) received scores ranging from 61 to 100 and were categorized as having a light dependence. Categorizing MSBI scores into two major groups was based on a study conducted by Granger et al., which mentioned that an MSBI score of 60 represented a transition from heavy dependence on assistance to mild dependence. The same study also showed that an MSBI score >40 indicated that patients did not require vital help in their ADLs; patients who scored > 60 did not require surveillance, and they were able to perform ADLs with minimal assistance from other people. In contrast, all the study groups with MSBI scores <40 required supervision and assistance for all 10 of the MSBI assessment items, especially basic skills, such as eating, dressing, and sphincter muscle control [17,28].

**Correlation between Hypertension Risk Factors and Dependence on ADL Assistance in the Research Subjects**

Based on the results of the MSBI scores in relation to the correlation between hypertension risk factors and dependence on ADL assistance, 17 patients (38.6%) had mild dependence and 27 patients (61.4%) had heavy dependence. The minimum sample size required was 20 subjects from each group. Of the study subjects in the mild dependence category, 9 patients (20.5%) did not have hypertension risk factors and 8 patients (18.2%) had hypertension risk factors. Of the study subjects in the heavy dependency category, 8 patients (18.2%) did not have hypertension risk factors and the remaining 19 patients (43.2%) had hypertension risk factors. Caesar et al. [7], found that 48.3% of the study group with hypertension risk factors had a heavy dependence on ADL assistance and 20.7% had a light dependence. Moreover, 24.1% of the study subjects without hypertension risk factors were in the heavy dependence category and 6.9% were in the mild dependence category [7].

In the present study, the results based on systolic blood pressure grouped according to JNC 8 guidelines showed that most of the subjects had blood pressure classified as stage I hypertension (as
many as 25 patients [(56.8%)]. Furthermore, of the 44 patients, 8 (18.2%) had normal blood pressure, 9 (20.5%) had blood pressure classified as pre-hypertension, and 2 (4.5%) had blood pressure classified as stage II hypertension. Nastiti20 found significant differences among each of the systolic blood pressure groups: the highest group was stage II hypertension (as much as 46%), followed by stage I hypertension (26%), pre-hypertension (14%), and normal blood pressure (14%).

To determine the differences in motor output in the form of heavy dependence on assistance from both groups, two unpaired groups were analyzed using the chi-squared test; the resulting p-value was 0.122. A p > 0.05 indicates that there was no significant difference in motor output between the two groups, so the results showed no statistically significant difference between the two groups.

A study conducted by Danya et al. found no significant difference in MSBI outcomes for the stroke patient groups with controlled and uncontrolled hypertension risk factors (p = 0.455). Caesar et al. [7] also reported no significant association between the groups with or without hypertension risk factors for the Barthel Index score. However, both studies only included study subjects with ischemic stroke diagnosis.

Of all the stroke risk factors, hypertension is the easiest to control. Hypertension results in atherosclerosis and attenuation of the endothelium intima muscle of the vein due to high intravascular pressure. Weakening of the endothelial intima tunica is a risk factor for intracerebral aneurysm rupture. This was supported by a study conducted by Ying et al. [29], which identified the influence of vascular anatomy in the brain and hemodynamic factors on aneurysm rupture. Ying et al. [29] found that 65% of the group with hypertension suffered a hemorrhagic stroke that was due to intracerebral aneurysm rupture. Intracerebral artery rupture that generally occurs in the circle of Willis is most common in anterior cerebral arteries (ACA) and anterior communicating artery (ACoA) (56.6%), which are the most common locations of a rupture, followed by ACM and PCoA (43.3%) [30]. Kalula et al. also reported changes in the anatomy of the circle of Willis (40.7%), and the presence of an anomaly in the circle of Willis (46.9%) doubled the risk of ruptured aneurism more than in subjects without anomalies (29.6%) [30,31]. In patients with stroke risk factors, the worsening of MSBI scores for transfers, ambulation, and toilet use can be associated with the anatomy of the cortical homunculus and the risk of intracerebral artery rupture occurring in the ACA and ACM, which generally innervates the medial region of the brain that integrates the motion of the lower and upper limbs.

When associated with the acquisition of MSBI scores on each of the 10 assessment items, the group with hypertension risk factors showed total dependence on assistance with ADLs, such as the movement from chairs to beds, ambulation, climbing stairs, and the use of toilets. For the basic ADLs, such as feeding, dressing, and sphincter muscle control, patients tend to perform independently. Based on the interpretation of the MSBI assessment, a score of 0 on the transfer point from a chair to a bed means that the patient needs assistance from two or more people with or without equipment. Interpretation of a score of 0 for the ambulatory item with or without a wheelchair indicates that the patient needs total assistance and is only capable of passively moving with or without a wheelchair. The assessment of the use of toilets showed that the majority of patients with hypertension risk factors reported a 0 score; this indicates that the patient is completely dependent on assistance when using the toilet, cleaning himself/herself after using the toilet, putting on and taking off his/her clothes. In a group of patients with hypertension risk factors, the scores for the other assessment items, such as bowels and bladder, bathing, dressing, dressing, and eating, showed that the patients were either self-sufficient or their dependency tended to be mild [6,16].

**Correlation between Diabetes Mellitus Risk Factors and Dependence on ADL Assistance in the Research Subjects**

Based on the results of the MSBI scores for the correlation between diabetes mellitus risk factors and the study subjects’ dependence on ADL assistance, 17 patients (38.6%) without diabetes mellitus risk factors and 1 patient (2.3%) with diabetes mellitus risk factors were in the mild dependency category, and 13 patients (29.5%) without diabetes mellitus risk factors and the 14 patients (31.8%) with diabetes mellitus risk factors were in the heavy dependency category. The minimum number of
samples required was 14 subjects from each group. Caesar et al. reported that 51.7% of the participants in the group with diabetes mellitus risk factors were in the heavy dependency category and 13.8% were in the mild dependency category [7]. In the group without diabetes mellitus risk factors, 20.7% were in heavy dependency category and 13.8% were in the mild dependency category [7]. In comparison, the current study showed that there was a difference in the distribution of dependence on ADL assistance based on the MSBI scores in the groups with and without hypertensive risk factors.

To determine if there was difference in motor output in chronic phase stroke patients in both study groups in terms of heavy dependence on ADL assistance, bivariate analysis of two unpaired groups was conducted using the chi-squared test (p = 0.002). The p value >0.05 denoted the rejection of H0, which stated that there was no difference in motor output between the two groups. The results showed a statistically significant difference between the two groups. The groups with diabetes mellitus risk factors had lower motor output as measured by the MSBI scores.

The health burden caused by strokes is significant considering the increasing prevalence of diabetes mellitus in countries in Southeast Asia (ASEAN), including Indonesia [3,29,32]. However, this is not supported by research data in Indonesia that describes the correlation between motor output of stroke patients and diabetes mellitus risk factors. The increased prevalence of stroke results in an increased incidence of ischemic and hemorrhagic strokes, although strong diabetes risk factors have only been associated with ischemic stroke [32]. This supports the finding that diabetes mellitus is one of the dominant factors that can increase the risk of stroke by 1.5- to 3-fold [33,34].

Ernest et al. [35] reported that diabetes mellitus caused lacunar infarction of arteries in the brain parenchyma that triggered stroke (p = 0.003), especially in risk groups in which the age of the subjects was 55 or older and the HbA1C levels were greater than or equal to 6.5. In two other studies, the groups were categorized as patients with stroke risk factors had a fasting blood glucose level >7.0 mmol/L or a blood glucose level >11.1 mmol/L or as patients taking antidiabetic drugs or as patients who had been diagnosed with a previous stroke [23,36]. The present study did not distinguish between type 1 and type 2 diabeteses.

The association between stroke and diabetes mellitus risk factors is due to increased blood viscosity, which increases the risk of atherosclerosis in the blood vessels of the brain. About 60% of ischemic stroke patients have diabetes mellitus. Lacunar infarction is also caused by poor glycemic control in diabetic patients. This is consistent with the results of a previous study that found that risk factors for diabetes have a strong association with post-stroke heavy dependence on assistance with ADLs [37]. Thus, diabetes mellitus is a significant factor in the incidence of lacunar infarction in stroke. Increased prevalence of diabetes mellitus may be the reason for the emergence of heavy post-stroke dependence on ADL assistance in patients with lacunar infarction.

Cardioembolic infarction is a subtype of ischemic infarction that has the highest mortality rate in the acute stroke phase. When compared with lacunar infarct, the mortality rate of cardioembolic infarction was found to be 27.3%, the mortality rate of lacunar infarction was 0.8% [37]. Cardioembolic infarction has been found to be associated with poor post-attack outcome, length of hospitalization duration, and functional limitations in comparison to other types of strokes [23,37]. Patients with diabetes mellitus tend to have higher body mass index (BMI) and higher systolic blood pressure and diastole blood pressure than patients without diabetes mellitus. Other study has reported that the hypertension prevalence in groups with diabetes mellitus was twice as high as those without diabetes mellitus. Patients with diabetes mellitus tend to have an increased risk of ischemic and hemorrhagic strokes because that condition increases the risk for and the prevalence of other risk factors, such as obesity, hyperlipidemia, and hypertension [33].

The strong link between a low MSBI score and diabetes mellitus risk factors and severe dependence on ADL assistance in chronic stroke patients is supported by Emiliano et al. [38] who reported that stroke patients with diabetes mellitus tended to have cognitive impairment (CI) and dependence on ADL assistance. That study did not elaborate on the specific dependencies, but it revealed that diabetes patients were more prevalent in urban areas, due to a sedentary lifestyle.
(p = 0.033), and it compared depression in diabetic patients with non-diabetic patients at a ratio of 3:2 and worse Mini-Mental State Examination (MMSE) scores, but no significant difference was found between the two groups in terms of the Seven Minute Screen Test results [38]. As described above, ADLs, such as feeding, grooming, controlling the sphincter muscles that affect the bowels and bladder, and dressing, are basic skills and involve movements with finer motor coordination in comparison to other activities, such as transfers, ambulation, and the use of the toilet [17,28]. In the present study, the results of the MSBI assessment showed that patients with diabetes mellitus risk factors tended to experience heavy dependence on assistance for performing basic skills, such as feeding, dressing, and sphincter muscle control. For the bowels and bladder component, the majority of study subjects with diabetes mellitus risk factors had an MSBI score of 0; thus, they had incontinence. Those with an MSBI score of 0 on the assessment of the bladder either had incontinence or used a catheter.

In the present study, the groups with diabetes mellitus risk factors showed severe dependence on assistance for the majority of ADLs, and they obtained a 0 MSBI score for bathing, dressing, personal hygiene and grooming, and eating. The interpretation of the 0 score for the dressing component means that the patient is dependent on assistance for all aspects of dressing, such as putting on, buttoning, and removing clothing. Interpretation of the 0 score for the components of self-cleaning and grooming means that the patient is unable to do all aspects related to personal care, such as hair straightening, wearing makeup, etc. Interpretation of the 0 score for the assessment component of feeding means that the patient is either unable to use cutlery or uses a nasogastric tube [6,16]. In the present study, the group with diabetes risk factors was relatively capable of performing migration, ambulation, climbing stairs, and toilet use, independently; this result is supported by Emiliano et al., who found no difference in outcomes from the Seven Minute Screen Test between groups with or without diabetes mellitus risk factors [38]. The low acquisition of MSBI scores and severe dependence on ADL assistance for patients with diabetes mellitus risk factors was associated with the intrinsic conditions of the blood vessels in the brain. As noted in a cohort study conducted by Dirk et al., microalbuminuria is one of the factors that contributes to the slow recovery of chronic phase stroke patients; however, that study only investigated ischemic stroke patients with diabetes mellitus who had never undergone hemodialysis treatment, peritoneal dialysis, or renal transplantation [39].

The condition of microalbuminuria in patients with diabetes mellitus was also supported by studies conducted by Satchel et al., who found that microalbuminuria in diabetic patients was caused by a glomerular filtration disorder resulting in the loss of many proteins in urine (albuminuria or proteinuria) due to changes in the microstructure in the glomerulus [40]. The mechanism that causes changes in the glomerular structure due to decreased and even loss of systemic vascular endothelial glucose remains unclear. Singh et al. [41] showed that the loss of glyocalyx in glomerular endothelial cells (GENs) was due to hyperglycemia in patients with diabetes mellitus who had reduced glycosaminoglycan (GAG) heparan sulfate biosynthesis; the absence of GAG heparan sulfate (one of the molecular components of glyocalyx) in GEnC causes the loss of protein and albumin in glomerulus filtration. In addition, microalbuminuria was associated with interstitial endothelial tunica thickening in all blood vessels, including cerebral blood vessels; other indications can be seen with poor Ankle Brachial Index (ABI) values, increased risk of macro and microvascular diseases, decreased functional ability, and risk factors for cardio-cerebrovascular disease [39,40].

This cross-sectional study provides an overview of the acquisition of MSBI scores and their association with hypertensive stroke and diabetes mellitus risk factors so that inter-variable correlations could be seen clearly. The study also contributes to the literature by examining the distribution of the characteristics of chronic phase stroke patients, which is expected to provide a broad overview of the condition of these patients under current conditions. However, this research has some limitations, one of which is its use of a cross-sectional study design. Thus, the researchers were only able to identify the characteristics of the stroke patients once during the study period or during rehabilitation. This study only used the data of chronic stroke patients, whereas, according to research conducted Jose et al. [32] rehabilitation programs should be initiated since the acute and subacute
phases play an important role in the final output, including the motor function that determines the success of conducting the AKS [32]. This study was the first to use MSBI assessment scales for chronic phase post-stroke patients’ AKS in Indonesia.

4. Conclusion
From the logistic regression test results, we can conclude that diabetes mellitus was the main predictor of heavy dependence on ADL assistance for chronic phase stroke patients. Patients with hypertensive risk factors experienced more severe dependence on assistance for transfers, climbing stairs, and using toilets. The group with diabetes mellitus risk factors experienced more heavy dependence assistance for nearly all aspects of the MSBI assessment. A person with a hypertension risk factor was four-times more likely to have severe post-stroke dependence on ADL assistance than a patient without hypertensive risk factors, while patients with diabetes mellitus risk factors were 22.7 times more likely to have severe post-stroke dependence on ADL assistance than patients without diabetes mellitus risk factors. Subsequent studies should include more samples and multicenter sampling sites.

References
[1] WHO. 2008 Fact Sheet : The Top Ten Causes of Death. [Internet]. [cited, 2016 Jan 10]. [Available from: http://tinyurl.com/jfymmg].
[2] Wiryawan R P 2009 Rehabilitasi Stroke pada Pelayanan Kesehatan Layanan Primer. (Jakarta: IDI).
[3] Koji A, Suhail A, Craig A, Hamidon B, Christoper L, Man Mohan M, et al. 2015 Asia Pacific Stroke Conference 2015: Annual Conference of the Asia Pacific Stroke Organization (APSO). (Kuala Lumpur: Karger).
[4] Mozaffarian D, Benjamin R J, Go A S, Arnelt D K, Biaha M J, Cushman M, et al. 2015 Heart Disease and Stroke Statistics- at a Glance. [Internet]. [cited, 2017 Jan 15]. Available from: http://bit.ly/1PX310T.
[5] Venketasubramanian N 2010 The epidemiology of stroke in ASEAN countries. Neurol. J. Southeast Asia. 50 734-42 [Internet]. [cited, 2016 Jan 10]. Available from: http://tinyurl.com/zs6gmsy.
[6] Kementerian Kesehatan RI 2014 Pusat Data dan Informasi Kementerian Kesehatan RI: Status dan Analisis Hipertensi. (Jakarta: Infodatin Kemenkes RI).
[7] Caesar K 2014 Hubungan Faktor Risiko Hipertensi dan Diabetes Melitus terhadap Keluaran Motorik Stroke Non Hemoragik. Thesis Paper (Semarang: Universitas Diponegoro) [cited, 2016 Okt 10]. Available from: http://bit.ly/2zfPxm2.
[8] Paul A J, Suzanne O, Barry L C, William C C, Cheryl D H, Joel H, et al. 2014 Evidence based guideline for the management of high blood pressure in adult. 2007 1-14. [Internet]. [cited, 2016 Fed 5]. Available from: http://tinyurl.com/zn7lk6o.
[9] Henry R B and Jong Y Y 2007 A New Classification scheme for hypertension based on relative and absolute risk with implications for treatment and reimbursement. 28 719-24 [Internet]. [cited, 2016 Jan 28]. Available from: http://hyper.ahajournals.org/content/28/5/719.full.
[10] Kayce B, June T and Bernie R O 2015 Hypertension: The Silent Killer: Updated JNC-8 Guideline Recommendations. [Internet]. 2015 Jun 1. [cited, 2017 Jan 28]. Available from: http://tinyurl.com/gv89r4o.
[11] Kementerian Kesehatan RI 2014 Pusat Data dan Informasi Kementerian Kesehatan RI: Status dan Analisis Diabetes. (Jakarta: Infodatin Kemenkes RI).
[12] Ellen L A and Brett M K 2007 Diabetes, the metabolic syndrome, and ischemic stroke. 30 3131-40 [Internet]. [cited, 2017 Jan 10]. Available from:http://care.diabetesjournals.org/content/30/12/3131.full.
[13] Sid S 2009 Stroke pathophysiology. Neurol. J. Clin. [Internet]. 2009 Jul 13. [cited, 2016 Jan 10]. Available from: http://tinyurl.com/hbuwemp.
[14] Guyton C A and Hall J E 2011 Guyton and Hall textbook of medical physiology. 15th ed. *Insulin, Glucagon, and Diabetes Melitus*. (China: Saunders Elsevier) Chapter 78, p. 963-72.

[15] Clare H, Maynard W, Joanna B and Jonathan B 1999 Sensitivity of Shah, Vanclay and Coopers’s Modified Barthel Index. *Clin Rehabilitation*. 13 141-7 [Internet]. [cited, 2017 Jan 10]. Available from: http://journals.sagepub.com/doi/pdf/10.1191/02692159968105029.

[16] Shah, Vanclay and Cooper 2016 *Modified Barthel Index (Shah Version)* Form. Date Unknown. [cited, 2016 Jan 10]. Available from: http://www.health.wa.gov.au/circularsnew/attachments/143.pdf.

[17] Granger C V, Dewis L S, Peters N C, Sherwood C C and Barrett J E 1979 Stroke rehabilitation: Analysis of Repeated Barthel Index Measures. *Arch. Phys. Med. Rehabil*. 60 14-7 [Internet]. [cited, 2017 Feb 17]. Available from: http://europepmc.org/abstract/med/4205656.

[18] Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI 2013 Riset Kesehatan Dasar. [Internet] 2013 1 Dec. [cited 10 January 2016]. Available from: http://tinyurl.com/h7qnbs7.

[19] Kusuma Y, Venketasubramanian N, Kiemas L S and Misbach J. 2009 Burden of stroke in Indonesia. *Int. J. Stroke*. 4 379-80 [Internet]. [cited, 2017 Jan 10]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/19765126.

[20] Dian N. 2012 Gambaran Faktor Risiko Kejadian Stroke pada Pasien Stroke Rawat Inap di Rumah Sakit Krakatau Media Tahun 2011. [Internet]. 2012 Jan 20. [cited, 2017 Jan 15]. Available from: http://lib.ui.ac.id/file/?file=20289574-S-Dian%20Nastiti.pdf.

[21] Bilic I, Dzamonja G, Lusic I, Matijaca M and Caljkusic K 2017 Risk factors and outcome between ischemic and hemorrhagic stroke. *Acta. Clin. Croat*. 48 399-403 [Internet]. [cited, 2017 Feb 17]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/20405634.

[22] Klaus K A, Tom S O, Christian D and Lars P K 2009 Hemorrhagic and ischemic stroke compared. *AHA* 40 2068-72 [Internet]. [cited 10 January 2016]. Available from: http://stroke.ahajournals.org/content/40/6/2068.

[23] Higgins T 2013 Hba1c for screening and diagnosis of diabetes melitus. *Endocrine*. 43 266-73.

[24] Dawood A and Jason R 2015 *Rehab Meuasures: Barthel Index*. [Internet]. 7 Jan 2015. [cited, 2017 Jan 10]. Available from: http://tinyurl/ggqgwqhz.

[25] Elizabeth W 2013 The measurement properties of the original barthel index and its applicability to measure function with older adults: a systematic review. *7* 26-34. [Internet]. [cited, 2016 Jan 10]. Available from: http://tinyurl.com/zjpjknr.

[26] Hsieh Y W, Wang C H, Wu S C, Chen P C, Sheu C F and Jsieh C L 2007 Establishing the minimal clinically improtant difference of the Barthel Index in stroke patients. *Neurorebil. Neural. Repair*. 21 233-8 [Internet]. [cited, 2017 Feb 17]. Available from: http://tinyurl.com/j2egu8u.

[27] Louise M N, Hans K, Lisa G O, Karina B, Kaspe B M and Thomas M 2016 Comparison of self reported and performance based measures of functional ability in elderly patients in an emergency department: implication for selection of clinical outcome measures. *BMC Geriatr*. 16 199. [Internet]. [cited, 2017 Feb 20]. [Available from: http://tinyurl.com/gmjkvlvm]

[28] Hsueh I P, Lee M M and Hsieh C L 2009 Psychometric characteristic of the Barthel index for daily living index in stroke patients. *J. Formos. Med. Assoc* 100 520-32. [Internet]. [cited, 2017 Jan 10]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11678002.

[29] Ying Z, Xinjian Y, Yang W, Jian L, Chuanhui L, Linkai J, et al. 2014 Influence of morphology and hemodynamic factors on rupture of multiple intracranial aneurysms: matched pairs of ruptured-unruptured aneurysms located unilaterally in the anterior circulation. *BMC Neurol*. 14 253 [Internet]. [cited, 2017 Jan 21]. Available from: https://tinyurl.com/zhsqe5b.

[30] Marc A L, Bichun O and Michael C 2017 The role of circle of Willis anomalies in cerebral aneurysms rupture. *J. Neurointerventional. Surg*. 4 22-6 [Internet]. [cited, 2017 Feb 20]. Available from: https://tinyurl.com/gtma97q.
[31] Kalula N T, Masakiyo S and Fumitada H 1984 cerebral aneurysms and variation in the circle of Willis. *BMC Neurol.* 15 846-50 [Internet]. [cited, 2017 Feb 20]. Available from: http://tinyurl.com/zldl4oz.

[32] Jose C, Regolio L, Maria M, Joaquin S, Miguel B and Antoni D 2004 Blood pressure decrease during the acute phase of ischemic stroke is associated with brain injury and poor stroke *Outcome.* 35 520-6 [Internet]. [cited, 2017 Feb 17]. Available from: http://stroke.ahajournals.org/content/35/2/520.

[33] Jaakko T, Daiva R, Pekka J, Cinzia S and Erkki V 2006 Diabetes melitus as a risk factor for death from stroke. 27 210-15 [Internet]. [cited, 2017 Jan 10]. Available from: http://stroke.ahajournals.org/content/27/2/210.full.

[34] Henrik S E, Nakayama H and Olsen T D 1994 Effect of blood pressure and diabetes on stroke in progression. *Lancet.* 344 156–9 [Internet]. [cited, 2017 Jan 10].Available from: http://tinyurl.com/hf8d8yp.

[35] Ernest P S and Virgina C R 2012 Epidemiology and risk factors of cerebral ischemia dan ischemia heart diseases: similarities and differences. *Curr. Cardiol. Rev.* 6 138-49 [Internet]. [cited, 2017 Feb 17]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2994106/.

[36] American Diabetes Association. Position statement on standards of medical care in diabetes 2009. *Diabetes. Care.* 32 S13-S61.

[37] Adria A and Josefina A 2012 Acute cardioembolic cerebral infraction: answers to clinical questions. *Curr. Cardiol. Rev.* 8 54–67 [Internet]. [cited, 2017 Feb 20]. Available from: http://tinyurl.com/hhg7kgq.

[38] Emiliano R S, Sara M S, Maria C P, Diana P A, Jose I R and Manuel A G 2016 Cognitive impairment and dependence of patients with diabetes older than 65 years old in an urban area (DERIVA study). *BMC Geriatric.* 16 33 [Internet]. [cited, 2017 Feb 20].Available from: https://tinyurl.com/zwqk8xf.

[39] Dirk S, Christian W, Peter B, Tobias B, Ludger R and Mario S 2016 Microalbuminuria indicates long term vascular risk in patient after acute stroke undergoing in patient rehabilitation. *BMC Geriatric.* 162 102 [Internet]. [cited, 2017 Jan 10].Available from: https://tinyurl.com/jbmtc7.

[40] Satchel S C and Tookie J E 2008 What is the mechanism of microalbuminuria in diabetes: a role for the glomerular endothelium. *Diabetologia.* 51 714-25 [Internet]. [cited, 2017 Feb 20]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/2292427/.

[41] Sighn A, Friden V, Dasgupta I, Foster R R, Welsh G I, Tookie J E, et al. 2011 High glucose cause dysfunction of the human glomerular endothelial. *Am. J. Physiol. Renal. Physiol.* 300 F40-8 [Internet]. [cited, 2017 Feb 20].Available from: https://www.ncbi.nlm.nih.gov/pubmed/20980411.