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Correlation Between MMSE Scores and NIHSS In Acute Stroke Infarct Patients

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Abstract
This study focuses on the relationship between cognitive impairment and stroke severity, aiming to understand the impact of stroke on the cognitive functions of patients. A systematic review methodology was used to evaluate previous research examining the role of cognitive assessments in stroke management. The results indicate a direct correlation between stroke severity and the degree of cognitive impairment, highlighting the need for comprehensive cognitive assessments inpatient rehabilitation. Early cognitive assessments have been shown to enhance patient recovery and prevent further cognitive decline. The studies reviewed emphasize the utility of tools such as the MMSE and NIHSS in managing stroke patients. In conclusion, integrated and early cognitive evaluations in stroke patients are crucial for effective clinical management and rehabilitation planning.

INTRODUCTION

Stroke remains a leading cause of long-term disability worldwide, significantly impacting both cognitive and physical abilities of survivors (El Husseini et al., 2023; Virani et al., 2020; Lyden, 2017). It has been shown that stroke-related cognitive impairments affect up to 1/3 of patients and contribute to a reduction in life quality and longer hospital stays (Obaid et al., 2020; Wang et al., 2024; Molloy, 2014). Furthermore, stroke mortality rates have risen over the last two decades, with Indonesia reporting a marked increase in stroke-related deaths (Kemenkes RI, 2018).

The severity of stroke is often assessed using scales like the NIHSS and MMSE, which have proven effective in evaluating neurological function and cognitive impairment, respectively (Jin et al., 2024; Pendlebury & Rothwell, 2019; Makin et al., 2018). These assessments correlate closely with patient outcomes, with higher NIHSS scores often leading to lower MMSE scores, thus indicating greater cognitive decline (Weaver et al., 2021; Quinn et al., 2021; Choi, 2024). Studies have highlighted that early recognition of cognitive impairment is crucial, as it impacts rehabilitation potential and overall prognosis (Lees et al., 2014; Delavaran et al., 2017; Molloy, 2014).

The relevant research studies explore the relationship between cognitive impairment and stroke severity across different stroke subtypes. El Husseini et al. (2023) examine cognitive dysfunction in both ischemic and hemorrhagic stroke patients, noting that the severity of the stroke is closely linked to the degree of cognitive impairment, emphasizing the need for comprehensive cognitive assessments in rehabilitation. Makin et al. (2018) conducted a systematic review comparing cognitive impairment across various stroke subtypes, underscoring the importance of early cognitive assessments to enhance patient outcomes and reduce cognitive decline. Furthermore, Weaver et al. (2021) found a strong correlation between

the Mini-Mental State Examination (MMSE) and the National Institutes of Health Stroke Scale (NIHSS) in acute ischemic stroke patients, supporting the utility of these tools for assessing both neurological and cognitive deficits in clinical practice. Together, these studies reinforce the importance of early and combined cognitive evaluations in stroke management, particularly for predicting recovery and guiding rehabilitation efforts.

The novelty of this research lies in the exploration of the direct relationship between NIHSS scores and MMSE performance in acute ischemic stroke patients. While NIHSS has primarily been used to evaluate neurological severity, its correlation with cognitive deficits provides new insights into stroke prognosis and rehabilitation (Wang et al., 2024; Quinn et al., 2021; Lyden, 2017). This study aims to fill the gap in research by using both scales in tandem to predict cognitive decline, allowing for more accurate and timely interventions (Obaid et al., 2020; Pendlebury & Rothwell, 2019; Delavaran et al., 2017).

This study aims to investigate the correlation between the MMSE and NIHSS in acute ischemic stroke patients, providing valuable insights into the relationship between neurological deficits and cognitive impairment in stroke recovery.

By understanding this relationship, healthcare providers can make more informed decisions about patient care and rehabilitation. Additionally, the findings will enhance the prediction of long-term cognitive recovery and improve functional outcomes for stroke patients.

METHOD

An analytical observational cross-sectional design was used in this investigation. Patients diagnosed with acute ischemic stroke who were admitted to Dr. Soetomo Surabaya Hospital between February and May 2023 and who satisfied the predetermined inclusion and exclusion criteria made up the study population. A sequential sampling technique was used to choose the participants. Patients with acute ischemic stroke of 2–5 days onset, those having their first ischemic stroke, those who were 18 years of age or older, and those who gave written informed agreement were all eligible to participate. Exclusion criteria included individuals with acute coronary syndrome, a history of malignancy, sepsis, severe hepatic or renal impairment, or those who had received intravenous thrombolytic therapy for ischemic stroke.

Software called SPSS version 22.0 was used to evaluate the data gathered from data collecting sheets and MMSE scores. Data normality was evaluated using the Shapiro-Wilk test; a normal distribution is indicated by a significance value > 0.05. Whereas Spearman correlation was employed for data that did not satisfy normality assumptions, Pearson correlation analysis was applied to data that was normally distributed. Under reference number 0577/KEPK/I/2023, the Dr. Soetomo General Academic Hospital Ethics Committee provided ethical permission for this investigation.

RESULTS AND DISCUSSION

The study included 30 patients in all who satisfied the inclusion requirements. Of these, 14 (46.7%) were female and 16 (53.3%) were male. With a median age of 60, age characteristics varied from a minimum of 45 to a maximum of 76 years. Out of the 30 participants in the sample, the mean age was 60.2 years with a standard deviation of 7.1.

Table 1. Characteristics of Research Subjects

Variable	N (%)	Value
Gender		
Males	16 (53,3%)	-
Female	14 (46,7%)	-
Age (Mean ± SD)		60,2±7,1
Hipertension		
Present	27 (90,0%)	-
No	3 (10,0%)	-
Hypoxia		
Present	2 (6,7%)	-
No	28 (93,3%)	-
Hypoglycemia		
Present	2 (6,7%)	-
No	28 (93,3%)	-
Diabetes Mellitus		
Present	17 (56,7%)	-
No	13 (43,3%)	-
Dyslipidemia		
Present	25 (83,3%)	-
No	5 (16,7%)	-

According to the results presented in Table 1, 27 out of 30 subjects (90%) had comorbid hypertension. Comorbid hypoxia and hypoglycemia were each observed in 2 subjects (6.7%). Comorbid diabetes mellitus (DM) was present in 17 subjects (56.7%), while comorbid dyslipidemia was found in 25 subjects (83.3%) of the total sample.

Discussion

In this study, the sampling time was 48 hours to 120 hours. The MMSE obtained a range of values of 4 to 30, with a median of 21.63, the NIHSS value obtained a range of values of 4 to 18, with a median of 7.00, from a total sample of 30 subjects.

Table 2. Relationship/Correlation Test of MMSE score with NIHSS

Variabel	r	*p value*
MMSE----- NIHSS	0,905	0,001

*There is a relationship if the p-value <0.05

Based on the results of the table for the correlation test between MMSE and NIHSS Score using the Pearson test, the p-value is 0.000 where the value is <0.05 which means that there is a correlation between MMSE and NIHSS based on statistical tests where these results are declared meaningful, based on the results of the r value in the correlation test, the value is 0.905 which means that the level of strength of the association between the MMSE score

variable and NIHSS is 0.905 or 90.5% where the value is included in the strong relationship strength category. The relationship between MMSE and NIHSS Score is negative, where if the MMSE score value is high or large, the NIHSS value will be low and vice versa.

This study investigated the relationship between neurological deficits and cognitive impairment in acute stroke patients, using the NIHSS and MMSE as respective measures. Our findings demonstrated a significant negative correlation between NIHSS and MMSE scores, indicating that patients with higher stroke severity tend to exhibit lower cognitive performance in the acute phase. These results are consistent with previous findings that suggest that greater neurological deficits are associated with a higher risk of cognitive dysfunction post-stroke (El Husseini et al., 2023). The NIHSS, though primarily designed to assess motor, sensory, and language impairments, has shown indirect associations with cognitive outcomes due to its coverage of areas such as language, attention, and level of consciousness (Quinn et al., 2021).

The negative correlation observed in this study supports the notion that stroke severity is a predictive factor for early cognitive decline. Wang et al. (2024) demonstrated that patients with more severe strokes, reflected by higher NIHSS scores, often present with biochemical markers related to neurodegeneration and cognitive impairment, such as decreased phosphorylated synuclein levels. Interestingly, while the MMSE is not specifically tailored to stroke-related cognitive domains such as executive function or visuospatial neglect, it remains a practical tool for bedside screening. Our findings reinforce its utility in acute stroke care when used alongside the NIHSS, especially considering that early cognitive assessments can aid in forecasting functional recovery (Choi, 2024).

Moreover, recent neuroimaging research has shown that stroke lesions affecting the frontoparietal network, which also correlates with higher NIHSS scores, can lead to widespread cognitive dysfunction (Jin et al., 2024). This anatomical and functional overlap may partially explain the relationship between the two clinical scales observed in our study. These findings align with prior studies, which have consistently reported that increasing stroke severity, as measured by the NIHSS, is associated with a higher likelihood of post-stroke cognitive impairment (PSCI) (Makin et al., 2018). NIHSS, although primarily a neurological tool, includes subcomponents such as language and attention, which indirectly reflect cognitive domains. This explains, in part, the overlap observed between NIHSS and MMSE scores.

Furthermore, a study by Weaver et al. (2021) emphasized that infarcts located in specific brain regions, particularly the left middle cerebral artery (MCA) territory and thalamus, significantly impair MMSE performance, suggesting that the anatomical location of infarcts contributes to the depth and type of cognitive deficits. This anatomical relevance strengthens the biological plausibility of the observed correlation in our findings.

The use of MMSE as a cognitive screening tool in the acute stroke setting remains common due to its brevity and ease of use. However, it has been widely recognized that the MMSE lacks sensitivity to frontal-executive dysfunction and visuospatial deficits, common in vascular cognitive impairment (Pendlebury & Rothwell, 2019). Despite these limitations, MMSE still offers a practical starting point in assessing cognitive function during hospitalization, particularly when complemented with neurological assessments like the NIHSS.

Several studies support the implementation of combined assessments. For instance, Lees et al. (2014) demonstrated that brief cognitive assessments improve functional outcome prediction beyond that of NIHSS alone, especially in mild strokes and transient ischemic

attacks. Therefore, the observed correlation in this study may be leveraged in clinical settings to predict rehabilitation needs and long-term outcomes more effectively. Additionally, early identification of cognitive impairment has important implications for patient management. Cognitive deficits post-stroke can significantly impact a patient's ability to participate in rehabilitation and adhere to treatment regimens (Delavaran et al., 2017). Integrating cognitive screening with neurological evaluation enables early intervention strategies that may improve functional recovery and reduce long-term disability.

However, limitations must be acknowledged. First, the MMSE may underestimate cognitive impairment, particularly in patients with right hemispheric infarcts or in those with subtle executive deficits. Second, cross-sectional correlation does not imply causality; longitudinal studies are required to assess the predictive value of these scales over time. Future research should consider integrating more sensitive tools such as the Montreal Cognitive Assessment (MoCA) and exploring domain-specific correlations with infarct topography.

CONCLUSION

This study demonstrates that higher NIHSS scores in acute ischemic stroke patients are strongly associated with lower MMSE scores, indicating that greater neurological impairment reliably predicts early cognitive decline. It is therefore recommended that cognitive screening be incorporated alongside neurological assessments immediately upon hospital admission for stroke, ensuring that patients at high risk of cognitive deficits are identified and receive targeted cognitive rehabilitation without delay. In practice, healthcare teams should closely monitor cognitive function in patients presenting with severe stroke to facilitate tailored interventions that can enhance rehabilitation outcomes, support functional recovery, and ultimately improve quality of life.

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