

A2DS2 versus AIS-APS for Stroke-Associated Pneumonia in Acute Ischemic Stroke: A Prospective Validation Study

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ABSTRACT

Background: Stroke-associated pneumonia (SAP) is a frequent early complication of acute stroke. This study compared the prognostic performance of A2DS2 and the Acute Ischemic Stroke-Associated Pneumonia Score (AIS-APS) in first-ever acute ischemic stroke.

Subjects and Method: This prospective prognostic validation study consecutively enrolled 45 patients at Dr. Moewardi General Hospital, Surakarta, Indonesia, beginning in May 2026 and continuing until the planned sample was completed. Both scores were calculated at hospital admission before final SAP adjudication, and patients were observed through day 7 after stroke onset. SAP was classified using PISCES/mCDC criteria. Discrimination was assessed using paired ROC analysis and the DeLong test; cut-offs were selected by the Youden index, paired classification was compared using exact McNemar testing, and each score was examined in a separate univariable logistic regression model.

Results: SAP occurred in 31/45 patients (68.9%). A2DS2 was higher in SAP than non-SAP patients (median 7.00, IQR 1.00 vs. 3.50, IQR 4.00; $p < 0.001$), as was AIS-APS (mean 18.45, SD 3.20 vs. 8.50, SD 4.33; $p < 0.001$). AUCs were 0.98 (95% CI 0.96 to 1.00) for A2DS2 and 0.98 (95% CI 0.94 to 1.00) for AIS-APS ($\Delta\text{AUC} = 0.01$; 95% CI -0.03 to 0.05; $p = 0.655$). At study-derived cut-offs, A2DS2 ≥ 7 had 93.5% sensitivity and 100.0% specificity, while AIS-APS ≥ 16 had 90.3% sensitivity and 92.9% specificity; classification accuracy did not differ (McNemar $p = 0.625$).

Conclusion: A2DS2 and AIS-APS showed similarly high discrimination in this single-center cohort. The study-derived cut-offs require external validation before routine clinical implementation.

Keywords: A2DS2, AIS-APS, ischemic stroke, prognostic validation, pneumonia.

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BACKGROUND

Stroke-associated pneumonia (SAP) is a lower respiratory tract infection occurring during the first seven days after stroke onset and is associated with greater morbidity, mortality, and healthcare use. Indonesian hospital-based studies have reported clinically important post-stroke pneumonia burdens, although estimates vary by setting and case-mix (Muhafidzah et al., 2021; Bashir et al., 2022; Asril and Nikmawati, 2024; Septianingrum et al., 2025; Utomo et al., 2025). These local data support the need for reproducible early risk stratification rather than assuming that performance estimates from other populations apply directly to Indonesian stroke services.

The A2DS2 score uses age, atrial fibrillation, dysphagia, male sex, and stroke severity, whereas AIS-APS incorporates a broader set of clinical, functional, comorbidity, neurologic, imaging-location, and glucose variables. International validation studies and large contemporary cohorts show that both scores can discriminate SAP risk, but their relative performance and calibration vary across populations and stroke case-mix (Cugy and Sibon, 2017; Zapata-Arriaza et al., 2018; Ni et al., 2021; Zhang et al., 2022; Liang et al., 2023; Yu et al., 2022; Wang et al., 2024; Su et al., 2025; Wang et al., 2025). This variability is relevant because a score that performs well in one setting may not retain the same cut-off, calibration, or predictive values in another.

The evidence gap in Indonesia is therefore not the development of a new score, but local prognostic validation and direct comparison of two established instruments in patients with acute ischemic stroke. Published Indonesian studies have primarily described SAP frequency and risk factors rather than prospectively comparing A2DS2 with AIS-APS using paired discrimination and classification analyses

(Muhafidzah et al., 2021; Asril and Nikmawati, 2024; Septianingrum et al., 2025). This study aimed to compare the prognostic discrimination and study-specific classification performance of A2DS2 and AIS-APS for SAP in first-ever acute ischemic stroke at Dr. Moewardi General Hospital.

SUBJECTS AND METHOD

1. Study Design and Reporting

This was an analytical observational prognostic validation study with a prospective cohort approach. The manuscript was prepared with reference to STROBE reporting for cohort studies and relevant TRIPOD principles for reporting validation of multi-variable prediction models. The study evaluated existing scores; it did not develop or refit a new SAP prediction score.

2. Study Site and Period

The study was conducted in the inpatient wards of Dr. Moewardi General Hospital, Surakarta, Indonesia. Recruitment began in May 2026 and continued until the planned sample of 45 participants was completed.

3. Population, Sampling, and Sample Size

The target population was patients with acute ischemic stroke, and the source population was patients treated at Dr. Moewardi General Hospital during the study period. Consecutive sampling was used. Eligible patients were aged ≥ 30 years, had first-ever acute ischemic/non-hemorrhagic stroke confirmed by a neurologist and brain CT and/or MRI, were admitted within seven days of stroke onset, and had complete data for both scores. Exclusion criteria were pneumonia preceding stroke onset or occurring after day 7, mechanical ventilation for a condition unrelated to the acute stroke, recurrent stroke, hemorrhagic stroke, or incomplete A2DS2/AIS-APS data.

The planned minimum sample was 40 participants, based on an expected SAP

proportion of 0.80 in a high-risk group versus 0.50 in a low-risk group, two-sided $\alpha = 0.05$, and 80% power. Forty-five participants were enrolled and all were analyzed. This calculation was based on contrasting expected outcome proportions rather than a prespecified target precision for AUC estimation; therefore, confidence intervals are reported for performance measures and the small validation sample is explicitly considered in interpretation.

4. Index Time and Follow-up

The index time for score assessment was hospital admission. A2DS2 and AIS-APS were calculated from admission information, verified, and locked before final SAP outcome adjudication. Follow-up for the SAP outcome ended at day 7 after stroke onset, so patients admitted later after stroke onset had a shorter prospective observation interval. Pneumonia that preceded stroke onset was excluded. The source protocol did not separately document exclusion of SAP that had already developed between stroke onset and hospital admission; this potential limitation in temporal separation is acknowledged in the Discussion.

5. Study Variables and Operational Definitions

Stroke-associated pneumonia (SAP).

SAP was the dependent outcome and was defined as a lower respiratory tract infection occurring within seven days after acute ischemic stroke onset. The study applied PISCES/mCDC criteria: at least one systemic criterion (fever $>38^{\circ}\text{C}$ without another known cause; leukopenia $<4,000/\text{mm}^3$ or leukocytosis $>12,000/\text{mm}^3$; or age ≥ 70 years with altered mental status without another known cause) plus at least two respiratory criteria (new or changed purulent sputum/increased secretions or suctioning; new or worsening cough, dyspnea, or tachypnea $>25/\text{min}$; crackles/bronchial breath sounds; or worsening gas

exchange/increased oxygen requirement or $\text{PaO}_2/\text{FiO}_2 \leq 240$). Definite SAP additionally required a new, progressive, or persistent infiltrate, consolidation, or cavity on appropriate chest radiography; probable SAP met the clinical criteria without confirmatory serial radiography and without a better alternative diagnosis. Probable and definite SAP were both coded as SAP=1 for the primary analysis (Suryatenggara and Munthe, 2025).

A2DS2. The score was calculated at admission by summing age ≥ 75 years (+1), atrial fibrillation (+1), dysphagia (+2), male sex (+1), and NIHSS category (0-4=0; 5-15=+3; ≥ 16 =+5), producing a total of 0-10.

AIS-APS. The score was calculated at admission from age group (≤ 59 =0; 60-69=2; 70-79=5; ≥ 80 =7), atrial fibrillation (+1), congestive heart failure (+3), COPD (+3), active smoking (+1), pre-stroke dependence with mRS ≥ 3 (+2), NIHSS (0-4=0; 5-9=2; 10-14=5; ≥ 15 =8), GCS (13-15=0; 9-12=0; 3-8=3), dysphagia (+3), OCSF infarct subtype (LACI/PACI=0; TACI/POCI=2), and admission glucose (≤ 11.0 mmol/L=0; ≥ 11.1 mmol/L=2), yielding a total of 0-35.

Dysphagia. Dysphagia was recorded as a binary admission clinical/medical-record component for both scoring systems. A separate validated bedside dysphagia screening instrument was not prespecified in the available study protocol; therefore, no specific scale or inter-rater reliability estimate is claimed in this report.

6. Measurements and Outcome Adjudication

Data sources included medical records, structured study forms, A2DS2 and AIS-APS checklists, brain CT/MRI, chest radiography, electrocardiographic/ clinical history data, and laboratory results. All participants underwent brain CT without contrast and/or MRI for ischemic stroke

confirmation and a baseline chest radiograph. Serial chest radiography was planned around day 5 of hospitalization or earlier when clinically indicated. Participants were monitored for systemic and respiratory signs, laboratory abnormalities, alternative diagnoses, and radiologic changes through day 7 after stroke onset.

Final SAP classification used the totality of clinical, laboratory, radiologic, alternative-diagnosis, and timing information. Cases were adjudicated as non-SAP, probable SAP, or definite SAP; where source documentation did not support a more specific PISCES subclassification, final investigator adjudication was used. The score values were locked before final outcome adjudication. Formal blinding of outcome adjudicators to score values, assessor training procedures, and inter-rater reliability were not documented in the available study protocol and are therefore not asserted.

7. Data Analysis

Normality was assessed with the Shapiro-Wilk test. Continuous variables were summarized as mean and standard deviation (SD) when normally distributed or median and interquartile range (IQR) otherwise; categorical variables were presented as n (%). A2DS2 was compared between SAP and non-SAP groups with the Mann-Whitney U test, while AIS-APS was compared using the independent-samples t test after group-specific normality and variance assessment. The AIS-APS mean difference is reported with a 95% confidence interval.

Discrimination was assessed by ROC curves and AUC with 95% confidence intervals. Because both scores were measured in the same participants, AUCs were compared with the paired DeLong test. Study-specific cut-offs were selected with the Youden index. At each cut-off, true-positive, true-negative, false-positive, and

false-negative counts, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated with 95% confidence intervals. Paired classification correctness for the two scores was compared using the exact two-sided McNemar test.

Two separate univariable logistic regression models were fitted, one with continuous A2DS2 and one with continuous AIS-APS. The scores were not entered together in a multivariable model, so the resulting odds ratios are not interpreted as independent adjusted effects. Results are reported as B, standard error, odds ratio (OR), 95% confidence interval, p value, Nagelkerke R^2 , Hosmer-Lemeshow goodness-of-fit p value, and classification accuracy. Analyses used IBM SPSS Statistics version 26; two-sided $p < 0.05$ was considered statistically significant.

8. Research Ethics

This study was approved by the Health Research Ethics Committee of Dr. Moewardi General Hospital, Surakarta, Indonesia (Ethical Clearance No. 864/V/HREC/-2026). Institutional permission to conduct the study was obtained from Dr. Moewardi General Hospital (Research Permit No. 893/6.365/2026). Written informed consent was obtained from all participants or their legal representatives. Participant confidentiality was maintained throughout data collection, analysis, and reporting.

RESULTS

1. Study Characteristics

Forty-five patients were screened and included; no participant was excluded or discontinued after enrollment, and all 45 contributed to the final outcome analysis. SAP occurred in 31 patients (68.9%), comprising 20 definite SAP and 11 probable SAP; 14 patients (31.1%) did not develop SAP. All 31 SAP outcomes were verified as

occurring within seven days after stroke onset.

The mean age was 59.36 years (SD 11.45; range 30-85), 23 participants (51.1%) were male, the median stroke-onset-to-admission interval was 3 days (IQR 4; range 0-7), median NIHSS was 17 (IQR 12), and median GCS was 14 (IQR 6). Dysphagia was recorded in 29 participants (64.4%). Table 1 presents general baseline characteristics separately from the components contributing to A2DS2 and AIS-APS; variables shared by both scores are identified within each score-specific section.

Data are mean $\pm$ SD, median (IQR), or n (%), as appropriate. General baseline

characteristics are separated from score components. Variables shared by A2DS2 and AIS-APS are intentionally repeated within each score-specific section to make score membership explicit. COPD=chronic obstructive pulmonary disease; GCS=Glasgow Coma Scale; mRS=modified Rankin Scale; NIHSS=National Institutes of Health Stroke Scale; OSCP=Oxfordshire Community Stroke Project; LACI=lacunar infarction; PACI=partial anterior circulation infarct; TACI=total anterior circulation infarct; POCI=posterior circulation infarct; SAP=stroke-associated pneumonia.

Table 1. Baseline characteristics and score components in the study cohort (n=45)

Characteristic	Values
General baseline characteristics	
Participants analyzed (n, %)	45 (100.0%)
Age (years old) (Mean, SD)	59.36 (11.45); range (min. 30 – max. 85)
Stroke onset to admission, days	3.00 (IQR 4.00); range (min. 0 – max. 7)
NIHSS	17.00 (IQR 12.00); range (min. 2 – max. 27)
GCS	14.00 (IQR 6.00); range 4-15
SAP / non-SAP (n, %)	31 (68.9%) / 14 (31.1%)
Definite / probable SAP	20 / 11
Completed outcome assessment (n, %)	45 (100.0%)
Components contributing to A2DS2	
Age (≥ 75 years contributes 1 point) (Mean, SD)	Overall age: Mean= 59.36; SD= 11.45; range (min. 30 – max. 85)
Atrial fibrillation (n, %)	5 (11.1%)
Dysphagia (n, %)	29 (64.4%)
Sex (male) (n, %)	23 (51.1%)
NIHSS ≥ 16 (highest A2DS2 category) (n, %)	30 (66.7%)
Components contributing to AIS-APS	
Age (≤ 59 / 60-69 / 70-79 / ≥ 80 categories)	Overall age: (Mean= 59.36; SD= 11.45); range (min. 30 – max. 85)
Atrial fibrillation (n, %)	5 (11.1%)
Congestive heart failure (n, %)	3 (6.7%)
COPD (n, %)	9 (20.0%)
Active smoking (n, %)	13 (28.9%)
Pre-stroke mRS ≥ 3 (n, %)	30 (66.7%)
NIHSS ≥ 15 (highest AIS-APS category) (n, %)	30 (66.7%)
GCS 13-15 / 9-12 / 3-8 (n, %)	26 (57.8%) / 8 (17.8%) / 11 (24.4%)
Dysphagia (n, %)	29 (64.4%)

Characteristic	Values
OCSF subtype LACI/PACI/TACI/POCI (n, %)	32 (71.1%) / 7 (15.6%) / 4 (8.9%) / 2 (4.4%)
Admission glucose ≥ 11.1 mmol/L (n, %)	19 (42.2%)

2. Score Distribution According to SAP Status

Each score was compared separately between the SAP and non-SAP groups. A2DS2 was higher in the SAP group than in the non-SAP group (median 7.00, IQR 1.00 vs. 3.50, IQR 4.00; Mann-Whitney $U=7.00$; $Z=-5.34$; $p<0.001$). AIS-APS was also higher in the SAP group (mean 18.45, SD 3.20 vs. 8.50, SD 4.33; mean difference=9.95; 95% CI 7.63 to 12.28; $t=-8.63$; $p<0.001$).

Dysphagia was associated with SAP on the prespecified categorical comparison (Fisher exact $p=0.002$): SAP occurred in 25 of 29 patients with dysphagia (86.2%) and in 6 of 16 patients without dysphagia (37.5%). Thus, 86.2% refers to the proportion of patients with dysphagia who developed SAP, not the proportion of all SAP patients who had dysphagia.

Table 2. Distribution of A2DS2 and AIS-APS Scores According to SAP Status

Score	Non-SAP (n=14)	SAP (n=31)	Effect/test	p
A2DS2	3.50 (IQR 4.00)	7.00 (IQR 1.00)	Mann-Whitney $U=7.00$; $Z=-5.34$	<0.001
AIS-APS	Mean= 8.50; SD= 4.33	Mean= 18.45; SD= 3.20	Mean difference=9.95 (95% CI 7.63 to 12.28); $t=-8.63$	<0.001

3. Discrimination and Diagnostic Classification

A2DS2 had an AUC of 0.98 (SE 0.02; 95% CI 0.96 to 1.00; $p<0.001$) and AIS-APS an AUC of 0.98 (SE 0.02; 95% CI 0.94 to 1.00; $p<0.001$). The paired DeLong comparison showed no statistically significant difference ($\Delta AUC=0.01$; 95% CI -0.03 to 0.05; $z=0.45$; $p=0.655$).

The study-derived cut-off A2DS2 ≥ 7 yielded TP/TN/FP/FN counts of 29/14/0/2, with sensitivity 93.5% (95% CI 78.6 to 99.2), specificity 100.0% (95% CI 76.8 to 100.0), PPV 100.0% (95% CI 88.1 to 100.0), NPV 87.5% (95% CI 61.7 to 98.4), and accuracy 95.6% (95% CI 84.9 to 99.5). AIS-APS ≥ 16 yielded 28/13/1/3, sensitivity 90.3% (95% CI 74.2 to 98.0), specificity 92.9% (95% CI 66.1 to 99.8), PPV 96.6% (95% CI 82.2 to

99.9), NPV 81.3% (95% CI 54.4 to 96.0), and accuracy 91.1% (95% CI 78.8 to 97.5).

For paired classification correctness, both scores were wrong in 1 patient, A2DS2 was wrong/AIS-APS correct in 1, A2DS2 correct/AIS-APS wrong in 3, and both were correct in 40. Exact two-sided McNemar testing showed no significant difference in classification accuracy ($p=0.625$).

Paired AUC difference (A2DS2 minus AIS-APS)=0.01 (95% CI -0.03 to 0.05; $z=0.45$; $p=0.655$). Exact McNemar comparison of classification correctness: both wrong= 1; A2DS2 wrong/AIS-APS correct= 1; A2DS2 correct/AIS-APS wrong=3; both correct=40; $p=0.625$. Cut-offs were selected with the Youden index and evaluated in the same cohort.

Table 3. Prognostic discrimination and study-derived classification performance of A2DS2 and AIS-APS

Parameter	A2DS2 ≥ 7	AIS-APS ≥ 16
AUC (95% CI)	0.98 (0.96 to 1.00)	0.98 (0.94 to 1.00)
Study-derived cut-off	≥ 7	≥ 16
TP/TN/FP/FN	29/14/0/2	28/13/1/3
Sensitivity, % (95% CI)	93.5 (78.6 to 99.2)	90.3 (74.2 to 98.0)
Specificity, % (95% CI)	100.0 (76.8 to 100.0)	92.9 (66.1 to 99.8)
PPV, %	100.0	96.6
NPV, %	87.5	81.3
Accuracy, % (95% CI)	95.6 (84.9 to 99.5)	91.1 (78.8 to 97.5)

4. Logistic Regression

In separate univariable continuous-score models, each one-point increase in A2DS2 was associated with higher odds of SAP (OR=7.66; 95% CI 2.07 to 28.31; $p=0.002$), and each one-point increase in AIS-APS was also associated with higher odds of SAP (OR=2.08; 95% CI 1.28 to 3.38; $p=0.003$). These odds ratios are not directly comparable because one point represents different component weights and score ranges. A2DS2 had Nagelkerke $R^2=0.83$ and 93.3%

classification accuracy but Hosmer-Lemeshow $p=0.024$, indicating evidence of calibration misfit. AIS-APS had Nagelkerke $R^2=0.80$, 88.9% classification accuracy, and Hosmer-Lemeshow $p=0.993$.

Each column represents a separate univariable model with SAP as the binary outcome. H-L=Hosmer-Lemeshow goodness-of-fit test; OR=odds ratio; SE=standard error. The models are not mutually adjusted, and the term “independent predictor” is not used.

Table 4. Separate univariable logistic regression models for SAP

Variables	b	95% CI		p
		Lower limit	Upper limit	
A2DS2 continous	2.04	2.07	28.31	0.002
Nagelkerke $R^2 = 0.83$				
Hosmer-Lemeshow $p = 0.024$				
Classification accuracy = 93.3%				
AIS-APS continous	0.73	1.28	3.38	0.003
Nagelkerke $R^2 = 0.80$				
Hosmer-Lemeshow = 0.993				
Classification accuracy = 88.9%				

DISCUSSION

This prospective single-center validation found very high discrimination for both A2DS2 and AIS-APS, but the difference between their AUCs was small and not statistically significant. Paired classification

accuracy at the study-derived cut-offs was also not significantly different. The appropriate interpretation is therefore that both scores separated SAP from non-SAP patients well in this cohort, not that one score was proven superior. Large external cohorts have

reported more modest discrimination and variation in comparative performance, underscoring the importance of population-specific validation (Cugy and Sibon, 2017; Wang et al., 2025).

The SAP proportion of 68.9% was higher than in several published cohorts. The study population contained a large proportion of severe neurologic deficits: 66.7% had NIHSS ≥ 16 , 64.4% had dysphagia, and 42.2% had GCS ≤ 12 . These characteristics provide a plausible case-mix explanation, but the present study did not formally test referral status or stroke severity as causes of the high SAP prevalence, so causal attribution should be avoided. Other hospital cohorts have demonstrated that stroke severity and swallowing disturbance are associated with SAP (Assefa et al., 2022; Wu et al., 2021; Muhl et al., 2022; Shi et al., 2022).

The dysphagia denominator requires particular care. SAP occurred in 25/29 patients with dysphagia (86.2%), whereas 6/16 patients without dysphagia (37.5%) developed SAP. This finding supports an association between the recorded dysphagia variable and SAP in this cohort, but it does not establish dysphagia as the sole causal mechanism. Post-stroke aspiration risk, reduced cough and airway protection, and immunologic changes may coexist, while microbiologic and host factors also contribute to pulmonary infection (Westendorp et al., 2022; Díaz-Marugan et al., 2023; Aboufotouh et al., 2024).

The apparently perfect specificity and PPV of A2DS2 at ≥ 7 should not be interpreted as perfect prediction. They resulted from zero false-positive classifications among only 14 non-SAP patients, with wide confidence intervals. In addition, both optimal cut-offs were selected and evaluated in the same cohort, which can inflate apparent performance. Contemporary validation studies show that score performance

depends on clinical spectrum and setting (Wang et al., 2025). Accordingly, A2DS2 ≥ 7 and AIS-APS ≥ 16 should be regarded as study-specific thresholds requiring external validation rather than universal clinical cut-offs.

The regression findings also require restrained interpretation. A2DS2 and AIS-APS were fitted in separate univariable models, not together in an adjusted multivariable model. Therefore, the reported ORs quantify the association of each continuous score with SAP but do not establish either score as an independent predictor after covariate adjustment. The large A2DS2 OR and wide 95% confidence interval reflect the steep separation of scores in this small sample; importantly, the Hosmer-Lemeshow result ($p=0.024$) suggests calibration misfit despite high discrimination and classification accuracy. The AIS-APS model showed better calibration in this dataset, consistent with the principle that discrimination and calibration are distinct properties of a prediction model.

This study has several limitations. First, it was conducted at a single center with 45 participants and only 14 non-SAP outcomes, limiting precision and increasing the risk of optimistic internal performance estimates. Second, the sample-size calculation was not based on target AUC precision. Third, the eligibility window allowed admission up to seven days after stroke onset while SAP was defined within the same seven-day period; late presentation could shorten prospective observation and may weaken temporal separation between score assessment and outcome. The source protocol excluded pneumonia before stroke onset but did not separately document exclusion of SAP already present at admission. Fourth, dysphagia was recorded as a binary clinical/medical-record score component without a prespecified validated swallowing

instrument in the available protocol. Fifth, although scores were locked before final SAP adjudication, formal blinding of outcome adjudicators, assessor training, and inter-rater reliability were not documented. Finally, cut-offs were derived and tested in the same cohort and should be externally validated.

In conclusion, A2DS2 and AIS-APS demonstrated similarly high discrimination for SAP in this cohort, with no significant difference in paired AUC or classification accuracy. A2DS2 is simpler, whereas AIS-APS incorporates broader clinical information and showed better calibration in the present dataset. These findings support further external, preferably multicenter validation with standardized dysphagia assessment and a clearly separated admission index time before either score or its study-specific cut-off is used for routine clinical decision-making.

AUTHOR CONTRIBUTIONS

Setyo Yuli Widyastuti: conceptualization, methodology, investigation, data collection, data curation, formal analysis, and writing-original draft. Jatu Aphridasari: conceptualization, methodology, supervision, interpretation of results, and writing-review and editing. Yusup Subagio Sutanto: conceptualization, methodology, supervision, interpretation of results, and writing-review and editing. Subandi: methodology, neurological and clinical validation, interpretation of results, and writing-review and editing. Harsini: supervision, validation, interpretation of results, and critical revision of the manuscript. A. Farih Raharjo: supervision, validation, interpretation of results, and critical revision of the manuscript. All authors reviewed and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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