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sarcopenia; physical activity, haemodialysis; nutritional status; CKD

## Low Physical Activity is Strongly Associated with Sarcopenia in Indonesian Haemodialysis Patients

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**ABSTRACT: Background:** Sarcopenia is a clinically important complication of maintenance haemodialysis (MHD), but evidence on associated factors in Indonesian patients remains limited. This study aimed to identify the independent factors associated with sarcopenia in this population.

**Methods:** This multicentre cross-sectional study evaluated the proportion of sarcopenia and factors independently associated with it among 134 adults with end-stage kidney disease receiving MHD at three hospitals in Makassar, Indonesia. Sarcopenia was defined according to the Asian Working Group for Sarcopenia 2019 criteria using appendicular skeletal muscle mass index measured by bioelectrical impedance analysis, handgrip strength, and physical performance. Physical activity was assessed using the International Physical Activity Questionnaire. Associations were examined using chi-square tests, followed by multivariable logistic regression for variables with  $p < 0.25$ .

**Results:** Sarcopenia was present in 75 participants (56.0%), including 39 (29.1%) with severe sarcopenia. On multivariable analysis, low physical activity (OR 53.5, 95% CI 10.25–278.80;  $p < 0.001$ ), underweight status (OR 15.7, 95% CI 2.55–96.94;  $p = 0.003$ ), age  $\geq 60$  years (OR 4.2, 95% CI 1.35–12.89;  $p = 0.013$ ), and male sex

(OR 4.1, 95% CI 1.41–11.86;  $p = 0.010$ ) were independently associated with sarcopenia. Sarcopenia affected more than half of the studied MHD population.

**Conclusions:** Sarcopenia is highly prevalent among patients receiving maintenance haemodialysis in Makassar. Low physical activity emerged as the strongest independent risk factor, followed by other factors. Routine sarcopenia screening, physical activity assessment, and nutritional evaluation may help identify MHD patients who require targeted preventive and rehabilitative strategies.

## 1. INTRODUCTION

Chronic kidney disease (CKD) is defined as persistent abnormalities in kidney structure or function for at least three months and is classified into five stages according to estimated glomerular filtration rate (eGFR), as outlined in the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 guideline [1]. Globally, the 2023 Global Burden of Disease (GBD) study estimated that

approximately 788 million adults were living with CKD, more than double the 378 million cases reported in 1990, with an age-standardised prevalence of 14.2% [2]. In Indonesia, the 2018 National Basic Health Research (Riskesdas) reported a CKD prevalence of 0.38% (3.8 per 1,000 population), with hypertension and diabetes mellitus identified as the leading underlying causes [3].

As CKD progresses to end-stage kidney disease (ESKD), renal replacement therapy becomes mandatory. Haemodialysis (HD) is the most widely used modality worldwide, with approximately 4 million patients currently dependent on this treatment [4]. Patients undergoing maintenance haemodialysis (MHD) are exposed to a chronic catabolic environment characterised by uraemic toxin accumulation, chronic inflammation, metabolic acidosis, protein-energy wasting (PEW), intradialytic amino acid losses, and hormonal dysregulation — all of which synergistically accelerate skeletal muscle loss [5,6].

Sarcopenia is a progressive syndrome characterized by loss of skeletal muscle mass accompanied by reduced muscle strength and/or impaired physical performance, resulting in increased risk of falls, disability, hospitalization, and mortality [7]. The Asian Working Group for Sarcopenia 2019 (AWGS 2019) consensus defines sarcopenia as the combination of low muscle mass (assessed by ASMI) with low muscle strength (handgrip strength  $<28$  kg in men or  $<18$  kg in women) and/or low physical performance (gait speed  $<1.0$  m/s, SPPB  $\leq 9$ , or five-times chair stand test  $\geq 12$  seconds) [8].

The prevalence of sarcopenia among MHD patients is considerably higher than in the general population. A global meta-analysis of 140 studies involving 42,041 CKD patients reported a sarcopenia prevalence of 24.5%, with higher rates in dialysis patients (26.2%) compared to non-dialysis CKD patients [9]. In Indonesia, reported proportions range widely from 15.9% to 82.5% depending on the diagnostic criteria and study centre [10,11].

Despite the expanding body of evidence, studies characterizing the risk factor profile of sarcopenia among patients receiving maintenance haemodialysis in Indonesia remain limited, particularly in regions outside Java. A comprehensive understanding of both modifiable and non-modifiable risk factors is essential for developing targeted preventive and therapeutic strategies. Therefore, this study was conducted to determine the proportion of sarcopenia and to identify its independent risk factors among patients undergoing maintenance haemodialysis at three tertiary referral haemodialysis centres in Makassar, South Sulawesi, Indonesia.

## 2. MATERIALS AND METHODS

### 2.1 Study Design

This multicentre cross-sectional study was conducted between January and June 2026 at three haemodialysis centres in Makassar, Indonesia: Wahidin Sudirohusodo General Hospital, Hasanuddin University Hospital, and Ibnu Sina Hospital.

### 2.2 Participants and Sampling

Adult patients ( $\geq 18$  years) with ESKD undergoing regular MHD for at least 3 months were eligible for inclusion. Patients with incomplete data, acute illness, active malignancy, or inability to perform physical performance tests were excluded. Consecutive sampling was applied. The minimum sample size of 134 subjects was calculated using a two-proportion formula based on a reference sarcopenia proportion of 54.2% versus 30.3% in MHD patients, with  $\alpha=0.05$  and  $\beta=0.20$ .

### 2.3 Assessment of Sarcopenia

Sarcopenia was defined and classified according to AWGS 2019 criteria [8]. Muscle mass was assessed using bioelectrical impedance analysis (BIA) and expressed as appendicular skeletal muscle mass index (ASMI = appendicular muscle mass [kg] / height<sup>2</sup> [m<sup>2</sup>]). Low muscle mass was defined as ASMI  $\leq 7.0$  kg/m<sup>2</sup> in men and  $\leq 5.7$  kg/m<sup>2</sup> in women. Muscle strength was assessed by handgrip strength (HGS) using a hand dynamometer; low HGS was defined as  $<28$  kg in men and  $<18$  kg in women. Physical performance was assessed using gait speed over a 6-metre course ( $<1.0$  m/s), Short Physical Performance Battery (SPPB  $\leq 9$ ), and five-times chair stand test ( $\geq 12$  seconds). Patients were classified as having sarcopenia if low muscle mass coexisted with low muscle strength and/or low physical performance, and as severe sarcopenia if all three criteria were met.

### 2.4 Variables and Data Collection

Independent variables included: (1) sex; (2) age, categorised as  $<60$  years or  $\geq 60$  years; (3) HD duration (3– $<6$  months vs. 6–12 months); (4) HD frequency (low  $\leq 2$  sessions/week vs. standard 3 sessions/week); (5) diabetes mellitus (yes/no); (6) physical activity

level, assessed using the International Physical Activity Questionnaire (IPAQ) and categorised as low, moderate, or high; and (7) nutritional status assessed by body mass index (BMI), categorised as underweight ( $<18.5 \text{ kg/m}^2$ ), normal ( $18.5\text{--}24.9 \text{ kg/m}^2$ ), overweight ( $25.0\text{--}29.9 \text{ kg/m}^2$ ), or obese ( $\geq 30.0 \text{ kg/m}^2$ ).

## 2.5 Statistical Analysis

Data were analysed using SPSS version 26. Categorical variables are presented as frequency and percentage. Bivariate associations between each risk factor and sarcopenia were evaluated using Chi-square tests, with odds ratios (OR) and 95% confidence intervals (CI) calculated. Variables with  $p < 0.25$  on bivariate analysis were entered into a multiple logistic regression model using the backward elimination method to identify independent risk factors. Statistical significance was set at  $p < 0.05$ .

## 3. RESULTS AND DISCUSSION

### 3.1 Participant characteristics

A total of 134 patients were enrolled (Table 1). The sample comprised 68 males (50.7%) and 66 females (49.3%), with a mean age of  $50.7 \pm 14.2$  years (range 20–79 years). The majority of subjects (69.4%) were under 60 years of age, while 30.6% were in the elderly group ( $\geq 60$  years). HD duration ranged from 3 to 12 months (mean  $6.5 \pm 3.1$  months), with 56.0% in the 6–12 months group. HD frequency was nearly equally distributed between low ( $\leq 2$  sessions/week, 48.5%) and standard (3 sessions/week, 51.5%) groups. Diabetes mellitus was present in 56.7% of subjects. Physical activity was predominantly low (45.5%) or moderate (36.6%), with only 17.9% reporting high physical activity. Most subjects had normal nutritional status by BMI (56.7%), with 15.7% underweight, 15.7% overweight, and 11.9% obese. The distribution of research subjects is presented in Table 1.

**Table 1.** Distribution of research subjects

| Variable                     | Category         | n  | %    | Min | Max | Mean | SD   |
|------------------------------|------------------|----|------|-----|-----|------|------|
| Sex                          | Female           | 66 | 49.3 |     |     |      |      |
|                              | Male             | 68 | 50.7 |     |     |      |      |
| Age (years)                  | $\geq 60$ years  | 41 | 30.6 | 20  | 79  | 50.7 | 14.2 |
|                              | $< 60$ years     | 93 | 69.4 |     |     |      |      |
| HD duration (months)         | 3– $< 6$ months  | 59 | 44.0 | 3   | 12  | 6.5  | 3.1  |
|                              | 6–12 months      | 75 | 56.0 |     |     |      |      |
| HD frequency (sessions/week) | Low ( $\leq 2$ ) | 65 | 48.5 | 1   | 3   | 2.5  | 0.5  |
|                              | Standard (3)     | 69 | 51.5 |     |     |      |      |
| Diabetes mellitus            | Yes              | 76 | 56.7 |     |     |      |      |
|                              | No               | 58 | 43.3 |     |     |      |      |
| Physical activity            | Low              | 61 | 45.5 |     |     |      |      |
|                              | Moderate         | 49 | 36.6 |     |     |      |      |
|                              | High             | 24 | 17.9 |     |     |      |      |

| Variable                 | Category          | n  | %    | Min | Max | Mean | SD |
|--------------------------|-------------------|----|------|-----|-----|------|----|
| Nutritional status (BMI) | Underweight       | 21 | 15.7 |     |     |      |    |
|                          | Normal            | 76 | 56.7 |     |     |      |    |
|                          | Overweight        | 21 | 15.7 |     |     |      |    |
|                          | Obese             | 16 | 11.9 |     |     |      |    |
| Sarcopenia               | Yes               | 75 | 56.0 |     |     |      |    |
|                          | No                | 59 | 44.0 |     |     |      |    |
| Sarcopenia severity      | Severe sarcopenia | 39 | 29.1 |     |     |      |    |
|                          | Sarcopenia        | 36 | 26.9 |     |     |      |    |

HD, haemodialysis; BMI, body mass index

## 3.2 Proportion of Sarcopenia

The proportion of sarcopenia was 56.0% (75 out of 134 subjects), comprising 29.1% severe sarcopenia (39 subjects) and 26.9% non-severe sarcopenia (36 subjects). This proportion is consistent with that reported by Jauwerissa et al. [11] (54.2%, n=96, RSCM Jakarta) using the same AWGS 2019 criteria, suggesting that the burden of sarcopenia among MHD patients in Indonesia is consistently high across different centres. This proportion is higher than the global figure of 26.2% for dialysis patients reported in the meta-analysis by Duarte et al. [9], and higher than the 21.8% reported in Chinese MHD patients by Yang et al. [12], which may reflect differences in physical activity profiles, nutritional status, and patient demographics.

## 3.3 Factors Associated with Sarcopenia in Bivariate Analysis

Male sex, age  $\geq 60$  years, low or moderate physical activity, and underweight or normal BMI were associated with sarcopenia in bivariate analyses (Table 2). The proportion of sarcopenia was 83.6% among participants with low physical activity compared with 12.5% among those with high physical activity. Underweight participants had a sarcopenia proportion of 81.0%, compared with 29.7% among overweight/obese participants. Diabetes mellitus, HD duration, and HD frequency were not significantly associated with sarcopenia.

**Table 2.** Risk Factors for Sarcopenia

| Variable | Category        | Sarcopenia Yes n (%) | Sarcopenia No n (%) | Total | p-value | OR (95% CI)     |
|----------|-----------------|----------------------|---------------------|-------|---------|-----------------|
| Sex      | Male            | 44 (64.7)            | 24 (35.3)           | 68    | 0.039   | 2.1 (1.04–4.14) |
|          | Female (ref)    | 31 (47.0)            | 35 (53.0)           | 66    |         | Reference       |
|          | $\geq 60$ years | 34 (82.9)            | 7 (17.1)            | 41    | <0.001  | 6.2 (2.48–      |

|     |                 |           |           |    |       |           |
|-----|-----------------|-----------|-----------|----|-------|-----------|
| Age |                 |           |           |    |       | 15.31)    |
|     | <60 years (ref) | 41 (44.1) | 52 (55.9) | 93 |       | Reference |
|     | 6–12 months     | 40 (53.3) | 35 (46.7) | 75 | 0.488 | NS        |

| Variable                    | Category                  | Sarcopenia<br>Yes n (%) | Sarcopenia<br>No n (%) | Total | p-value | OR (95% CI)        |
|-----------------------------|---------------------------|-------------------------|------------------------|-------|---------|--------------------|
| HD<br>duration              | 3–<6 months (ref)         | 35 (59.3)               | 24 (40.7)              | 59    |         | Reference          |
| HD<br>frequency             | Standard (3x/week)        | 41 (59.4)               | 28 (40.6)              | 69    | 0.407   | NS                 |
|                             | Low $\leq 2x$ /week (ref) | 34 (52.3)               | 31 (47.7)              | 65    |         | Reference          |
| Diabetes<br>mellitus        | Yes                       | 47 (61.8)               | 29 (38.2)              | 76    | 0.117   | NS                 |
|                             | No (ref)                  | 28 (48.3)               | 30 (51.7)              | 58    |         | Reference          |
|                             | Low                       | 51 (83.6)               | 10 (16.4)              | 61    | <0.001  | 35.7 (8.92–142.86) |
| Physical<br>activity        | Moderate                  | 21 (42.9)               | 28 (57.1)              | 49    | 0.009   | 5.3 (1.38–19.96)   |
|                             | High (ref)                | 3 (12.5)                | 21 (87.5)              | 24    |         | Reference          |
|                             | Underweight               | 17 (81.0)               | 4 (19.0)               | 21    | <0.001  | 10.0 (2.74–36.77)  |
| Nutritional<br>status (BMI) | Normal                    | 47 (61.8)               | 29 (38.2)              | 76    | 0.001   | 3.8 (1.65–8.90)    |
|                             | Overweight/Obese (ref)    | 11 (29.7)               | 26 (70.3)              | 37    |         | Reference          |

HD: haemodialysis; OR: odds ratio; CI: confidence interval; NS: not significant; ref: reference category. Chi-square test.

### 3.4 Factors Independently Associated with Sarcopenia

Multiple logistic regression included sex, age, physical activity, and nutritional status because these variables met the prespecified  $p < 0.25$  screening criterion. All four variables remained independently associated with sarcopenia. Low physical activity had the largest adjusted OR (53.5; 95% CI 10.25–278.80;  $p < 0.001$ ), followed by underweight status (OR 15.7; 95% CI 2.55–96.94;  $p = 0.003$ ), age  $\geq 60$  years (OR 4.2; 95% CI 1.35–12.89;  $p = 0.013$ ), and male sex (OR 4.1; 95% CI 1.41–11.86;  $p = 0.010$ ). Normal

BMI was not independently associated with sarcopenia compared with the overweight/obese reference group (OR 2.6; 95% CI 0.51–13.45;  $p = 0.251$ ).

**Table 3.** Independent Risk Factors for Sarcopenia

| Variable        | Category | B     | SE    | p-value | OR   | 95% CI     |
|-----------------|----------|-------|-------|---------|------|------------|
| Sex (Male)      |          | 1.408 | 0.543 | 0.010   | 4.1  | 1.41–11.86 |
| Age (≥60 years) |          | 1.427 | 0.576 | 0.013   | 4.2  | 1.35–12.89 |
| Moderate        |          | 2.457 | 0.578 | <0.001  | 11.7 | 3.76–36.26 |

| Variable                 | Category    | B     | SE    | p-value | OR   | 95% CI       |
|--------------------------|-------------|-------|-------|---------|------|--------------|
| Physical activity        | Low         | 3.979 | 0.843 | <0.001  | 53.5 | 10.25–278.80 |
| Nutritional status (BMI) | Normal      | 0.960 | 0.836 | 0.251   | 2.6  | 0.51–13.45   |
|                          | Underweight | 2.756 | 0.928 | 0.003   | 15.7 | 2.55–96.94   |

*High physical activity; Overweight/ Obese nutritional status. Multiple logistic regression — backward method.*

## 3.5 Discussion

In this multicentre cross-sectional study of 134 patients undergoing maintenance haemodialysis in Makassar, 56.0% met the AWGS 2019 criteria for sarcopenia. Multivariable logistic regression identified four factors independently associated with sarcopenia: low physical activity, underweight nutritional status, older age (≥60 years), and male sex. Low physical activity showed the strongest association, with the highest adjusted odds ratio (OR, 53.5), underscoring its potential importance as a modifiable target for sarcopenia prevention in this population.

The odds ratio for low physical activity increased from 35.7 in the bivariate analysis to 53.5 after multivariable adjustment, suggesting the presence of negative confounding in the unadjusted model. In the present cohort, male participants generally reported higher levels of physical activity than female participants. Because greater physical activity confers protection against sarcopenia, this imbalance partially attenuated the observed association between low physical activity and sarcopenia in the bivariate analysis. Following adjustment for age, sex, and nutritional status, the independent effect of low physical activity became more pronounced, indicating that its association had previously been underestimated.

Biologically, physical inactivity contributes to skeletal muscle loss by attenuating mechanotransduction-mediated activation of the mammalian target of rapamycin complex 1 (mTORC1), thereby reducing muscle protein synthesis. Concurrently, it promotes activation of the ubiquitin–proteasome system through Forkhead box O (FoxO) transcription factors, leading to increased expression of the muscle-specific E3 ubiquitin ligases Atrogin-1 and muscle RING finger-1 (MuRF-1). These molecular changes accelerate proteolysis and contribute to progressive muscle protein loss [13,14]. In patients undergoing maintenance haemodialysis, these catabolic processes may be further amplified by the uraemic environment, including chronic inflammation, metabolic disturbances, and anabolic resistance.

These findings are consistent with those of Chang et al. [15], who reported that higher levels of non-leisure-time physical activity were independently associated with a lower risk of sarcopenia among haemodialysis patients. Similarly, the meta-analysis by Jin et al. [16] demonstrated that regular exercise was associated with a substantial reduction in the likelihood of sarcopenia (adjusted OR 0.31; 95% CI 0.12–0.81), further supporting the protective role of physical activity in this population. Underweight nutritional status was the second strongest independent risk factor (OR 15.7). This finding directly reflects the role of protein-energy wasting (PEW), the hallmark of advanced CKD, in sarcopenia pathogenesis [6]. Chronic energy-protein deficit reduces amino acid substrate availability for muscle protein synthesis, forces protein catabolism via UPS activation, suppresses IGF-1-mediated PI3K–Akt–mTOR anabolic signalling, and is compounded by intradialytic amino acid losses of 6–12 g per session [5,6,17]. The paradoxical finding that the

overweight/obese group had the lowest sarcopenia proportion (29.7%) is consistent with the well-described 'reverse epidemiology' or 'obesity paradox' in dialysis populations, whereby higher BMI confers a relative metabolic reserve that is protective against catabolism [18]. However, this should be interpreted cautiously, as BMI in dialysis patients may be confounded by fluid overload, and sarcopenic obesity — characterised by high fat mass coexisting with low muscle mass — may not be adequately captured by BMI alone [18].

Age  $\geq 60$  years remained a significant independent risk factor (OR 4.2), though its adjusted OR was lower than its crude OR (6.2), indicating positive confounding in the bivariate analysis. Part of the apparent effect of ageing on bivariate analysis was attributable to age-related reductions in physical activity and nutritional status rather than to ageing per se. The residual adjusted OR of 4.2 represents the direct biological effect of ageing irreversible through modifiable interventions: decline in satellite cell number and regenerative capacity, shift in muscle fibre composition from type II to type I fibres, progressive anabolic resistance, and neuromuscular deterioration [19,20]. The synergism between primary (age-related) sarcopenia and secondary (uraemia-induced) sarcopenia creates a particularly destructive catabolic environment, explaining the very high sarcopenia proportion (82.9%) observed in the elderly MHD subgroup in this study.

Male sex was independently associated with sarcopenia (OR 4.1), with its adjusted OR exceeding its crude OR (2.1) — also a manifestation of negative confounding, as men in this study had higher average physical activity levels than women, partially masking their true biological risk at the bivariate level. The higher biological risk in men is attributed to greater testosterone deficiency in male CKD patients: uraemia directly impairs Leydig cell function and the hypothalamic-pituitary-gonadal axis, resulting in androgen deficiency that eliminates the anabolic effects of testosterone on myoblast proliferation, myostatin inhibition, and androgen receptor (AR)–IGF-1–mTOR anabolic signalling [19,21].

Diabetes mellitus, HD duration, and HD frequency were not significantly associated with sarcopenia in this study. The non-significance of DM ( $p=0.117$ ) is likely explained by the fact that all subjects were already in a severely catabolic uraemic state, which may have overwhelmed and masked the additional catabolic contribution of DM-related insulin resistance. The limited duration of HD exposure (3–12 months only) and narrow frequency range may have precluded detection of cumulative effects that may only become apparent with longer-term exposure, as also suggested by the meta-analysis of Jin et al. [16], which similarly found no significant association between dialysis vintage and sarcopenia (adjusted OR 0.48; 95% CI 0.19–1.20;  $p=0.117$ ).

Several limitations should be acknowledged when interpreting the findings of the present study. First, the cross-sectional design precludes the establishment of causal relationships between the identified risk factors and sarcopenia. Second, physical activity was assessed using the self-reported International Physical Activity Questionnaire (IPAQ) rather than objective measures such as accelerometry, which may have introduced recall and reporting bias. Third, several clinically relevant variables, including HbA1c, serum albumin concentration, and dialysis adequacy (Kt/V), were not evaluated, thereby limiting a more comprehensive assessment of the potential influence of glycaemic control, nutritional status, and dialysis quality on sarcopenia. Finally, the relatively narrow range of haemodialysis duration (3–12 months) may have reduced the ability to detect long-term, duration-dependent effects. Future longitudinal cohort studies incorporating extended follow-up, objective assessments of physical activity, and comprehensive biochemical and dialysis-related parameters are warranted to validate and expand upon the present findings.

Notwithstanding these limitations, the present study provides valuable multicentre evidence on the epidemiology of sarcopenia among patients receiving maintenance haemodialysis in Indonesia, particularly in regions outside Java where published data remain limited. The identification of low physical activity as the most influential independent risk factor, with an adjusted odds ratio of 53.5, highlights a readily modifiable target for clinical intervention. Current evidence supports the incorporation of structured exercise programmes, particularly intradialytic interventions combining resistance and aerobic training, as an integral component of routine haemodialysis care to preserve muscle mass and improve muscle strength in patients with sarcopenia [13]. In parallel, regular nutritional assessment accompanied by appropriate protein–energy supplementation in accordance with the KDOQI 2020 Clinical Practice Guideline [6] should be implemented to address the second most important modifiable risk factor and optimize patient outcomes.

## 4. CONCLUSION

Sarcopenia affected more than half of the patients receiving maintenance haemodialysis in this multicentre Indonesian cohort. Low physical activity showed the largest adjusted association with sarcopenia, while underweight status, age  $\geq 60$  years, and male sex were also independently associated. These findings support routine assessment of muscle health, physical activity, and nutritional status in MHD patients and provide a rationale for prospective studies evaluating exercise and nutritional interventions.

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## AUTHOR CONTRIBUTIONS

**Haerani Rasyid, Nur Audia Latamba, Agus Sudarso, Andi Makbul Aman, Sitti Rabiul Zatalia:** Conceptualization, Investigation.

**Haerani Rasyid, Nur Audia Latamba, Arifin Seweng, Hasyim Kasim:** Methodology, Laboratory Analysis.

**Haerani Rasyid, Nur Audia Latamba, Syakib Bakri, Nasrum Machmud, Akhyar Albaar:** Data Curation, Formal Analysis.

**Haerani Rasyid, Nur Audia Latamba, Khadijah Khairunnisa Hasyim, Achmad Fikry Faridin, Cornelia Parinussa:** Supervision, Writing—Review & Editing.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ETHICS STATEMENT

This study was approved by the Biomedical Research Ethics Committee, Faculty of Medicine Hasanuddin University, Makassar, South Sulawesi, Indonesia under the protocol number UH26030401. The study was conducted according to the principles of the Declaration of Helsinki.

## DATA AVAILABILITY STATEMENT

The de-identified dataset generated and analyzed during the current study is available from the corresponding author upon reasonable request. Access to the data is subject to applicable ethical, institutional, and privacy requirements.

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