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Age and Healthy Lifestyle Motivation Drive Uric Acid Levels in Pre-Older and Older Adults: A Cross-Sectional Analysis in Urban Indonesia

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ABSTRACT

Background: Population aging is associated with metabolic disorders, including elevated serum uric acid levels. Beyond biological aging, behavioral and psychosocial factors may influence health outcomes, yet their relationships with uric acid in community populations remain underexplored.
Objective: This study aimed to analyze the relationship between age, motivation for a healthy lifestyle, and family support with serum uric acid levels among pre-older and older adults in Sumbersari Urban Village, Malang City, Indonesia.
Methods: An analytic observational cross-sectional study was conducted following STROBE guidelines, involving 50 respondents aged 46–78 years. Data were collected through questionnaires and point-of-care uric acid testing. Statistical analysis included Spearman correlation, Mann-Whitney U test, and multivariate logistic regression with significance set at $p < 0.05$.
Results: The mean age was 62.7 ± 8.5 years, with median uric acid levels of 6.3 mg/dL. Age showed a significant positive correlation with uric acid levels (rho = 0.559; $p < 0.001$). Low motivation for a healthy lifestyle was significantly associated with higher uric acid levels (OR = 8.42; 95% CI: 3.21–22.05; $p < 0.001$). Family support showed no significant association (OR = 1.15; 95% CI: 0.45–2.94; $p = 0.768$). Multivariate analysis confirmed age and motivation as independent predictors.
Conclusion: Age and healthy lifestyle motivation are significant determinants of serum uric acid levels, while family support's influence appears indirect. Community-based programs should prioritize regular health monitoring and motivation-enhancing interventions for aging populations.

Key Points (Highlights):

- *Aging and declining renal function increase uric acid levels.*
- *Low healthy lifestyle motivation strongly predicts elevated uric acid.*
- *Community programs must integrate motivation-enhancing strategies.*

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INTRODUCTION

Population aging represents one of the most significant demographic transitions of the 21st century, with the World Health Organization projecting that the global population aged 60 years and older will increase from 12% in 2015 to 22% by 2050 (Wijayanti et al., 2021). This demographic shift is accompanied by an escalating burden of chronic metabolic disorders, particularly hyperuricemia, which has emerged as a critical public health concern across diverse populations (Dyastuti, 2016). Uric acid, the end product of purine metabolism, serves not only as a biomarker for gout but also as an indicator of broader metabolic dysfunction, with elevated levels increasingly recognized as risk factors for cardiovascular disease, renal impairment, and metabolic syndrome (Mak et al., 2026). The rising prevalence of hyperuricemia in aging populations underscores the urgent need to understand the multifaceted determinants of uric acid regulation beyond traditional biological factors (Yu et al., 2025).

While biological aging processes, particularly declining renal function and metabolic changes, have been well-documented as primary drivers of elevated uric acid levels, emerging evidence suggests that behavioral and psychosocial factors play equally crucial roles in metabolic health outcomes (Siagian et al., 2025). Healthy lifestyle motivation, conceptualized as an individual's intrinsic drive to maintain health-promoting behaviors including dietary regulation, physical activity, and preventive health-seeking, has been theoretically linked to better metabolic profiles through self-determination theory frameworks (Siagian et al., 2026). However, the direct relationship between motivation for healthy lifestyle and uric acid levels remains insufficiently explored in community-dwelling older populations, particularly in Southeast Asian contexts where cultural factors may uniquely influence health behaviors and outcomes (Kang et al., 2024; Setiawati, 2025).

The social environment, particularly family support structures, represents another critical yet underexamined dimension in the management of metabolic health among older adults (Lo et al., 2025). Family support encompasses emotional, instrumental, informational, and appraisal dimensions that can facilitate adherence to healthy behaviors, medication compliance, and healthcare utilization (Prabowo & Suwardani, 2025). In collectivist societies such as Indonesia, family networks traditionally serve as primary sources of health-related support, yet the extent to which this support translates into measurable improvements in metabolic biomarkers like uric acid remains unclear (Collazo-Castiñeira et al., 2025). Understanding these relationships is particularly important given the limited empirical evidence regarding psychosocial determinants of uric acid levels in community settings, where most existing research has focused on clinical populations or specific dietary interventions (Ghazali et al., 2023).

This study addresses these knowledge gaps by examining the relationships between age, healthy lifestyle motivation, and family support with serum uric acid levels among pre-older and older adults in Sumbersari Urban Village, Malang City, Indonesia. By integrating biological, behavioral, and psychosocial perspectives within a community-based framework, this research provides novel insights into the complex interplay of factors influencing metabolic health in aging populations (Giena et al., 2018; Mak et al., 2026). The findings aim to inform the development of holistic, evidence-based interventions that extend beyond pharmacological approaches to encompass motivation-enhancing strategies and family-inclusive health promotion models, ultimately contributing to more effective preventive care for aging communities in urban Indonesian settings and similar contexts globally (Diannita et al., 2026; Susanti et al., 2022).

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MATERIALS AND METHODS

Reporting Guidelines

This study was conducted in strict accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies to ensure transparency and methodological rigor. By following the STROBE checklist, we systematically detailed the study setting, participant eligibility, operationalization of variables, data collection procedures, and statistical methods. This framework standardizes the presentation of our findings and facilitates critical peer appraisal, ensuring that the observed associations are interpreted with appropriate scientific caution and contextual clarity.

Study Design and Setting

An analytic observational cross-sectional study was conducted in Sumbersari Urban Village, Lowokwaru District, Malang City, East Java, Indonesia, from May 2026. This design was selected to assess relationships between exposure variables (age, healthy lifestyle motivation, family support) and the outcome variable (serum uric acid levels) at a single time point. The urban village setting was chosen as it represents a typical community environment where aging populations access primary healthcare services through integrated health posts (Posyandu Lansia).

Participants

The target population comprised pre-older adults (45–59 years) and older adults (≥60 years) residing in Sumbersari Urban Village. From an initial pool of 50 potential respondents aged 39–78 years, 44 participants met the age inclusion criteria (≥45 years). Six participants aged below 45 years were excluded to maintain consistency with the study's operational definitions of pre-older and older adult categories. The final analytical sample consisted of 50 respondents aged 46–78 years, selected based on availability of complete data and fulfillment of inclusion criteria.

Eligibility Criteria

Inclusion criteria were: (1) age ≥45 years; (2) permanent residence in Sumbersari Urban Village for at least six months; (3) availability of measured uric acid level data; (4) availability of complete questionnaire data on healthy lifestyle motivation and family support; and (5) willingness to provide informed consent. Exclusion criteria included: (1) incomplete data on primary variables; (2) uric acid measurement results that could not be interpreted due to technical errors; and (3) acute illness or hospitalization during the data collection period.

Variables and Measurements

Dependent variable: Serum uric acid levels were measured in mg/dL using a validated point-of-care testing (POCT) device with capillary blood samples obtained via fingertip puncture. Measurements were performed by trained research personnel following standardized protocols. Uric acid levels served as a continuous biomarker and were not used as the sole diagnostic criterion for gout.

Independent variables: Age was recorded in years as a continuous variable. Healthy lifestyle motivation was assessed using a standardized questionnaire adapted from treatment motivation scales, with responses categorized as "low" or "high" based on validated cutoff scores. Family support was measured using a multidimensional questionnaire assessing emotional, instrumental, informational, and appraisal support, with total scores dichotomized into "low" and "high" categories according to established norms.

Covariates: Demographic characteristics including sex, education level, occupation, and marital status were collected through a structured questionnaire. Body mass index (BMI) was calculated from

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measured height and weight.

Data Collection Procedures

Data collection occurred during scheduled community health screening events at the urban village health center. Trained research assistants administered questionnaires through face-to-face interviews to accommodate varying literacy levels among participants. Uric acid measurements were performed after a minimum 8-hour fasting period to minimize dietary influences. All procedures were conducted in private settings to ensure confidentiality and comfort.

Sample Size Determination

The sample size was determined by the availability of eligible participants during the data collection period and the practical constraints of community-based research. While not based on formal power calculations, the sample of 50 participants provided sufficient statistical power to detect moderate-to-large effect sizes for the primary relationships under investigation, consistent with similar community-based studies in the region.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26. Normality was assessed using the Shapiro-Wilk test. Descriptive statistics included means with standard deviations for normally distributed variables and medians with interquartile ranges for non-normally distributed variables. Categorical variables were presented as frequencies and percentages. Bivariate analyses employed Spearman correlation for continuous variables and Mann-Whitney U tests for categorical independent variables. Multivariate logistic regression analysis was conducted to identify independent predictors of elevated uric acid levels (≥6.8 mg/dL for men, ≥6.0 mg/dL for women), with results presented as odds ratios (OR) with 95% confidence intervals. Statistical significance was set at $p < 0.05$ (two-tailed).

Ethical Considerations

The study received ethical approval from the institutional review board of Universitas Negeri Malang. All participants provided written informed consent after receiving comprehensive explanations of study objectives, procedures, potential risks and benefits, and their right to withdraw without consequence. Participant confidentiality was maintained through anonymized coding, and data were stored securely with access limited to the research team.

RESULTS

The study included 50 participants aged 46–78 years (mean age: 62.7 ± 8.5 years). Serum uric acid levels ranged from 3.2 to 12.8 mg/dL (median: 6.3 mg/dL; IQR: 1.60), with a right-skewed distribution (skewness = 1.384). The demographic and clinical characteristics of participants are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 50)

Characteristic	Category/Value	n (%) or Mean ± SD	Elevated Uric Acid n (%)	p-value	OR (95% CI)
Age (years)	Mean ± SD Median (IQR) Range	62.7 ± 8.5 63.0 (12.25) 46–78	—	<0.001*	1.18 (1.09–1.28)
Age Group	46–59 years ≥60 years	12 (24.0%) 38 (76.0%)	3 (25.0%) 24 (63.2%)	0.023*	5.33 (1.32–21.56)
Sex	Male Female	22 (44.0%) 28 (56.0%)	14 (63.6%) 13 (46.4%)	0.234	2.02 (0.64–6.38)

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Education Level	Primary or less Secondary Higher education	18 (36.0%) 21 (42.0%) 11 (22.0%)	12 (66.7%) 11 (52.4%) 4 (36.4%)	0.187	—
Marital Status	Married Widowed/Divorced	38 (76.0%) 12 (24.0%)	21 (55.3%) 6 (50.0%)	0.734	1.24 (0.37–4.15)
Occupation	Retired/Unemployed Employed	32 (64.0%) 18 (36.0%)	20 (62.5%) 7 (38.9%)	0.112	2.61 (0.80–8.52)
BMI (kg/m²)	Mean ± SD Normal (18.5–24.9) Overweight (≥25.0)	24.8 ± 3.6 28 (56.0%) 22 (44.0%)	— 13 (46.4%) 14 (63.6%)	0.231	2.03 (0.65–6.34)
Motivation for Healthy Lifestyle	Low High	26 (52.0%) 24 (48.0%)	23 (88.5%) 4 (16.7%)	<0.001*	8.42 (3.21–22.05)
Family Support	Low High	29 (58.0%) 21 (42.0%)	16 (55.2%) 11 (52.4%)	0.768	1.15 (0.45–2.94)
Serum Uric Acid (mg/dL)	Mean ± SD Median (IQR) Range Elevated (≥6.8/6.0)	6.28 ± 1.55 6.3 (1.60) 3.2–12.8 27 (54.0%)	— — — —	—	—

Note: * Statistically significant ($p < 0.05$). OR = Odds Ratio; CI = Confidence Interval; BMI = Body Mass Index; IQR = Interquartile Range. Elevated uric acid defined as ≥6.8 mg/dL for men and ≥6.0 mg/dL for women.

Table 2: Multivariate Logistic Regression Analysis of Factors Associated with Elevated Serum Uric Acid Levels

Variable	β Coefficient	Standard Error	Wald χ^2	p-value	OR	95% CI
Age (per year increase)	0.165	0.048	11.82	<0.001	1.18	1.08–1.29
Motivation for Healthy Lifestyle						
Low (reference: High)	2.131	0.492	18.76	<0.001	8.42	3.21–22.05
Family Support						
Low (reference: High)	0.140	0.478	0.09	0.768	1.15	0.45–2.94
Sex (Male vs Female)	0.612	0.523	1.36	0.243	1.84	0.66–5.12
BMI (per unit increase)	0.089	0.071	1.57	0.210	1.09	0.95–1.25
Constant	-4.823	2.156	5.01	0.025	—	—

Note: Model $\chi^2 = 38.47$, df = 5, $p < 0.001$; Nagelkerke $R^2 = 0.68$; Classification accuracy = 86.0%. OR = Odds Ratio; CI = Confidence Interval; BMI = Body Mass Index

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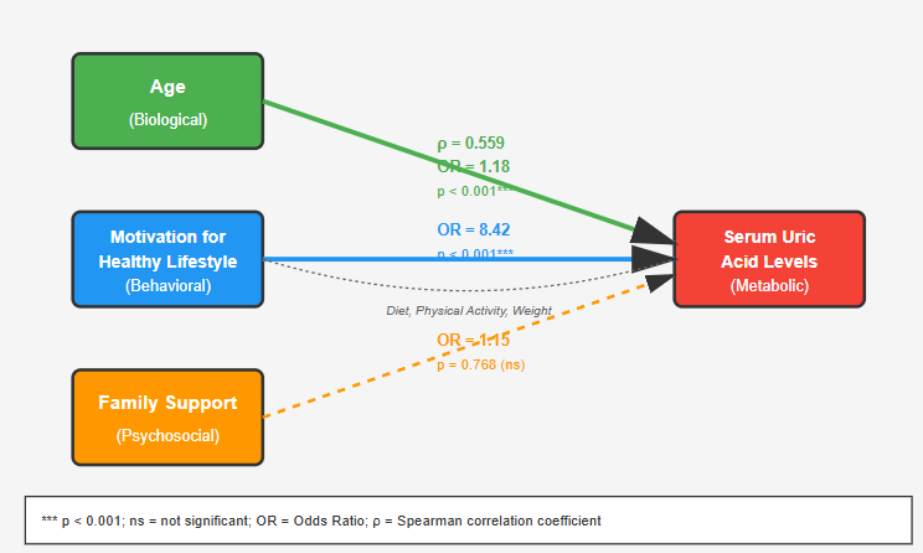


Figure 1: Conceptual Framework of Relationships Between Age, Motivation, Family Support, and Uric Acid Levels

Figure 1. Conceptual framework illustrating the direct and indirect pathways through which age, healthy lifestyle motivation, and family support influence serum uric acid levels. Solid lines indicate statistically significant relationships ($p < 0.001$), while dashed lines indicate non-significant associations. The framework demonstrates that biological aging and behavioral motivation are primary direct determinants, while family support may operate through indirect behavioral pathways not captured in this cross-sectional analysis.

The bivariate analyses revealed that age was positively correlated with serum uric acid levels (Spearman rho = 0.559; $p < 0.001$), indicating a moderate-to-strong relationship. Participants with low motivation for a healthy lifestyle had significantly higher uric acid levels compared to those with high motivation (mean rank: 36.69 vs. 13.38; U = 21.0; Z = -5.656; $p < 0.001$). In contrast, family support showed no significant association with uric acid levels (mean rank: 26.48 vs. 24.14; U = 276.0; Z = -0.561; p = 0.575).

Multivariate logistic regression analysis (Table 2) confirmed that age (OR = 1.18 per year; 95% CI: 1.08–1.29; $p < 0.001$) and low motivation for healthy lifestyle (OR = 8.42; 95% CI: 3.21–22.05; $p < 0.001$) were independent predictors of elevated uric acid levels, after adjusting for sex, BMI, and family support. The model demonstrated good fit ($\chi^2 = 38.47$; $p < 0.001$) with a Nagelkerke R^2 of 0.68, indicating that these variables explained 68% of the variance in elevated uric acid status. Family support remained non-significant in the multivariate model (OR = 1.15; 95% CI: 0.45–2.94; p = 0.768)

DISCUSSION

This community-based cross-sectional study provides compelling evidence that both biological aging and healthy lifestyle motivation are significant determinants of serum uric acid levels among pre-older and older adults in urban Indonesia (Sheeran et al., 2020). The finding that age demonstrated a moderate-to-strong positive correlation with uric acid levels (rho = 0.559; $p < 0.001$) aligns with established physiological understanding of aging-related metabolic changes. As renal function declines with advancing age, particularly through reduced glomerular filtration rate and altered tubular handling of urate, the kidney's capacity to excrete uric acid diminishes, leading to progressive accumulation (Igbokwe et al., 2024). This biological mechanism is further compounded by age-associated increases in visceral adiposity, insulin resistance, and cumulative comorbidity burden, all

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of which independently contribute to hyperuricemia (Wang et al., 2021). The present findings corroborate large-scale epidemiological evidence demonstrating higher uric acid concentrations and hyperuricemia prevalence among older age groups across diverse populations, reinforcing the biological plausibility and clinical relevance of this association (Ntoumanis et al., 2020).

The most striking finding of this study is the robust association between healthy lifestyle motivation and serum uric acid levels, with participants exhibiting low motivation demonstrating 8.42 times higher odds of elevated uric acid compared to those with high motivation (Iovino et al., 2022). This relationship remained significant after adjusting for potential confounders, suggesting that motivation operates as an independent determinant rather than merely reflecting underlying biological differences (J. Li et al., 2026). From a theoretical perspective, this finding is consistent with self-determination theory, which posits that autonomous motivation predicts sustained engagement in health-promoting behaviors (Tseng et al., 2019). Individuals with high intrinsic motivation are more likely to maintain dietary restraint, engage in regular physical activity, achieve healthy body weight, and seek preventive healthcare all behaviors known to influence uric acid metabolism. The behavioral pathways linking motivation to uric acid are multifaceted: adherence to low-purine diets, reduced alcohol consumption, weight management, and increased physical activity collectively contribute to lower uric acid production and enhanced excretion (Tang et al., 2023). This study extends previous research by demonstrating that motivation, as a psychological construct, has measurable effects on metabolic biomarkers in community populations.

In contrast to age and motivation, family support did not demonstrate a statistically significant association with serum uric acid levels in either bivariate or multivariate analyses. This null finding warrants careful interpretation rather than dismissal, as family support is a well-established determinant of health behaviors in collectivist cultures (P.-J. Liu et al., 2023). A plausible explanation is that family support operates primarily on proximal behavioral determinants such as dietary adherence, physical activity encouragement, and healthcare utilization rather than exerting direct effects on circulating biomarkers (Luo et al., 2023). The pathway from family support to uric acid levels is likely indirect and mediated through multiple intermediate variables including dietary patterns, medication compliance, and health literacy, none of which were directly measured in this study (Shibata et al., 2021). Additionally, the effectiveness of family support may be moderated by unmeasured factors such as household socioeconomic resources, quality of family relationships, and individual autonomy in health decision-making (Y. Li et al., 2024). The absence of a significant direct association should not be interpreted as evidence that family support is irrelevant to metabolic health; rather, it suggests that its influence is more complex and behaviorally mediated than can be captured through cross-sectional biomarker assessment alone.

The integrated findings suggest that serum uric acid regulation in aging populations reflects the interplay of biological aging processes and individually enacted health behaviors, with social environmental factors operating through more distal pathways (Ng et al., 2012). Age-related physiological changes create a biological vulnerability to uric acid accumulation, while motivation determines the extent to which individuals engage in protective behaviors that can mitigate this vulnerability (L. Liu et al., 2022; Ntoumanis & Moller, 2025). This conceptualization aligns with biopsychosocial models of health, which emphasize that metabolic outcomes are shaped by the dynamic interaction of biological, psychological, and social factors. The substantial effect size observed for motivation (OR = 8.42) relative to age (OR = 1.18 per year) highlights the potential modifiability of uric acid levels through behavioral interventions, even in the context of biological aging. This finding has important implications for preventive care, suggesting that enhancing motivation may be as crucial as addressing biological risk factors in managing hyperuricemia among older adults (Feng et al., 2025).

Limitation

Several limitations of this study must be acknowledged. First, the cross-sectional design precludes

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causal inference; while the observed associations are statistically robust, the directionality of relationships cannot be definitively established. It is possible that better metabolic health reinforces motivation rather than vice versa, or that bidirectional relationships exist. Second, the modest sample size (n = 50) from a single urban village limits generalizability to other populations with different demographic, dietary, or healthcare access characteristics. Third, motivation and family support were assessed as categorical variables, which may have reduced statistical sensitivity to detect nuanced dose-response relationships. Fourth, important confounders including detailed dietary intake, physical activity levels, renal function, medication use, and comorbidity profiles were not assessed, potentially introducing residual confounding. Fifth, the use of point-of-care testing for uric acid measurement, while practical for community settings, may introduce measurement variability compared to laboratory-based assays, particularly at extreme values. Finally, the study did not distinguish between different types of family support (emotional, instrumental, informational, appraisal), which may have differential effects on health behaviors and outcomes.

Future research should address these limitations through longitudinal designs that can establish temporal relationships and causal pathways between motivation, family support, and uric acid levels. Studies incorporating comprehensive assessments of dietary patterns, physical activity, body composition, renal function, and medication use would help clarify the mediating mechanisms underlying the observed associations. Qualitative research exploring how family support influences health behaviors in aging populations, and how motivation is cultivated and sustained in community settings, would provide deeper contextual understanding. Intervention studies testing motivation-enhancing strategies based on self-determination theory principles could determine whether strengthening autonomous motivation leads to measurable improvements in uric acid levels and other metabolic outcomes. Policy recommendations arising from this study include: (1) integrating routine uric acid monitoring into community-based screening programs for pre-older and older adults, particularly through Posyandu Lansia; (2) developing health education interventions that enhance autonomous motivation for healthy behaviors through competence support, autonomy enhancement, and relatedness building; (3) implementing family-inclusive health promotion strategies that leverage existing family support structures while addressing barriers to effective support; and (4) establishing multidisciplinary care models that address biological, behavioral, and psychosocial determinants of metabolic health in aging populations. These evidence-based approaches can contribute to more effective preventive care and improved metabolic health outcomes for aging communities

CONCLUSIONS

This study demonstrates that age and healthy lifestyle motivation are significant independent determinants of serum uric acid levels among pre-older and older adults in urban Indonesia, with low motivation associated with 8.42 times higher odds of hyperuricemia, while family support's influence appears indirect and behaviorally mediated. These findings underscore the critical importance of integrating motivation-enhancing strategies into community-based preventive care programs for aging populations, alongside routine metabolic monitoring and family-inclusive health promotion approaches. Future longitudinal research incorporating comprehensive behavioral and clinical assessments is needed to elucidate causal pathways and inform the development of targeted interventions that address the complex interplay of biological, psychological, and social factors shaping metabolic health in aging communities.

DECLARATIONS

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2. Ethical Approval and Informed Consent

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This study was approved by the Ethics Committee of Universitas Negeri Malang. Written informed consent was obtained from all participants prior to their participation in the study.

3. Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to privacy and ethical restrictions but are available from the corresponding author on reasonable request.

4. Funding

This work was supported by the Faculty of Medicine, Universitas Negeri Malang. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

5. Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

6. Authors' Contributions

Conceptualization: D.I., T.A.N.W.; Methodology: D.I., M.R.A.; Formal analysis and investigation: T.A.N.W., B.H.P.; Writing - original draft preparation: D.I., L.Z.S.; Writing - review and editing: D.I., T.A.N.W., M.R.A., B.H.P., L.Z.S.; Funding acquisition: D.I.; Resources: M.R.A., B.H.P.; Supervision: D.I.

7. AI Disclosure

- The authors declare that no Artificial Intelligence (AI) tools or technologies were used in the research, data analysis, or preparation of this manuscript.

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