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**MOBILE-ASSISTED PHONOLOGICAL TRAINING:
IMPROVING INDONESIAN EFL STUDENTS' INTELLIGIBILITY
IN ACADEMIC COMMUNICATION**

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Abstract: The growing demand for digital-based education in the 21st century highlights the need for innovative pronunciation teaching that supports clearer and more accessible academic English. Thus, this study investigated the effectiveness of mobile-assisted audio training in improving Indonesian EFL students' speech intelligibility in academic communication. Using a quasi-experimental pretest-posttest control group design, the study involved 60 twelfth grade students at a

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state senior high school in Aceh, Indonesia, equally divided into an experimental group and a control group. The experimental group received mobile-based audio training, while the control group received traditional pronunciation training. Data were collected through speech intelligibility tests, pronunciation accuracy rubrics and student perception questionnaires. Statistical analyzes including descriptive statistics, paired samples t-test, independent samples t-test and ANCOVA were performed using SPSS. The findings revealed a significant improvement in the intelligibility scores of the experimental group compared to the control group. In addition, the questionnaire results indicated that students in the experimental group reported higher levels of motivation, engagement, and positive perceptions toward mobile-assisted phonological training compared to the control group. The study emphasizes the pedagogical potential of integrating mobile technology into EFL pronunciation teaching in Indonesian secondary schools.

Keywords: *academic communication, EFL learners, mobile-assisted language learning, phonological training, pronunciation intelligibility*

INTRODUCTION

Phonological competence is considered one of the main pillars that support the effective learning of English as a Foreign Language (EFL). The hard work done in this area is mainly seen in the clear, intelligible, and academically appropriate spoken communication. Numerous studies conducted in the last ten years have pointed out that phonological awareness, pronunciation accuracy, and speech intelligibility are the crucial factors that determine the learners' oral proficiency, mainly when they are involved in academic tasks such as presentations, debates, and scholarly discussions (Hua, 2022; Mashudi, 2022; Peng, 2023). Notwithstanding this, several Indonesian learners of English as a foreign language face severe difficulties with

pronunciation because the phonological systems of their native language (L1) and the foreign language (L2) differ significantly. The problems caused by these differences typically result in low intelligibility, reduced listener comprehension, and poor performance in academic communication contexts.

Despite the aforementioned challenges, technological advancements in education have opened up new and efficient, flexible, and personalized methods for phonological learning to take place. One key area is Mobile-Assisted Language Learning (MALL), which enables language learners to use mobile devices for practicing pronunciation and provides features such as speech recognition, instant corrective feedback, and self-paced learning opportunities. Additionally, mobile apps like ELSA Speak, YouGlish, and AI-based pronunciation tools have proven quite effective in enhancing learners' phonological skills by providing them with continuous and personalized practice (Ebadijalal, 2022; Hu, 2023; Sutrisna, 2021). However, while international research has explored the use of MALL to improve general speaking skills, studies specifically investigating mobile-based audio training to improve intelligibility in academic communication are limited, especially in the Indonesian context (Alalwi, 2021; Çil, 2021).

Furthermore, previous research has predominantly focused on general oral proficiency rather than academic communication, which requires a higher level of phonological precision. For instance, Ebadijalal (2022) found that mobile-assisted learning significantly improved learners' speaking fluency and overall oral performance, but the study did not specifically address speech intelligibility in academic contexts. Similarly, Hu (2023) reported that mobile-based learning enhanced students' communicative competence and engagement; however, the focus remained on general speaking skills rather than phonological accuracy required in formal academic discourse. In addition, Sutrisna (2021) highlighted the effectiveness of mobile applications in improving vocabulary acquisition and speaking practice, yet did not examine how such tools contribute to learners' intelligibility in academic communication settings (Fathi,

2021; Junaidi, 2020; Susanti et al., 2020). Academic communication requires students to express ideas clearly, maintain accurate rhyme, and produce intelligible speech in a variety of academic settings. Despite its importance, the integration of intensive mobile-based audio training with the development of academic communication skills is an unexplored area of research. A review of recent literature, both in Sinta-indexed journals and internationally, reveals a notable gap in studies addressing this intersection.

At the same time, the need to improve the academic communication skills of Indonesian students has become increasingly urgent, especially with the implementation of the *Merdeka Belajar curriculum*, which emphasizes presentation skills, academic collaboration and global communication skills (Movva et al., 2022; Nurjati et al., 2023; Pratiwi, 2020; W. Yang & Lin, 2025). The discrepancy between these pedagogical requirements and students' current phonological abilities highlights an important research gap, indicating the need for an educational intervention that utilizes technology to not only improve pronunciation but also improve speech comprehension, especially in academic contexts.

Despite the growing body of research on mobile-assisted language learning, existing studies have largely focused on improving general speaking skills, learner motivation, and vocabulary development, with limited attention to speech intelligibility in academic communication contexts. Moreover, previous studies have not systematically examined how mobile-based phonological training can be structured to target both segmental and suprasegmental features required for clear and effective academic speech. This indicates a clear gap in the literature regarding the integration of mobile-assisted phonological training specifically designed to enhance intelligibility in academic discourse.

Considering this gap, the present study offers a novel approach by proposing the systematic implementation of mobile-based phonological training to enhance EFL learners' fluency and intelligibility in academic communication (Chang & Lan, 2021; Zaitun et al., 2021; Zhi, 2024). This integrated approach is still rarely

investigated in Indonesian EFL research and has strong potential to meet the learning demands of the 21st century. In addition, mobile technology supports personalized, flexible and autonomous learning, which makes it pedagogically advantageous compared to traditional pronunciation teaching.

Therefore, this study aims to address the identified gap in previous research, namely the limited investigation of mobile-assisted phonological training specifically targeting speech intelligibility in academic communication contexts (Mandasari & Wahyudin, 2021; Mardhatillah & Suharyadi, 2023; Nisha, 2024b). It examines the effectiveness of mobile-assisted audio training in improving the speaking intelligibility of Indonesian EFL learners, particularly in academic settings. The findings will likely contribute theoretically to the growing body of literature on MALL and applied phonology, and practically to language teachers and institutions seeking effective pronunciation instruction strategies tailored to contemporary educational needs.

METHOD

Research Design

This study employed a quasi-experimental pretest-posttest control group design to investigate the effectiveness of mobile-assisted audio training in improving the fluency of Indonesian EFL students in academic communication. The treatment was conducted over eight sessions within four weeks, with each session lasting approximately 90 minutes. During the intervention, the experimental group received mobile-assisted phonological training using applications that provided pronunciation practice, repetition drills, and immediate feedback on both segmental and suprasegmental features. In contrast, the control group received pronunciation instruction through conventional classroom-based activities, including teacher modeling and guided speaking practice without the use of mobile technology (Casulleras & Miralpeix, 2024; Yawiloeng, 2020). This design is suitable for educational settings where complete randomization is not always possible, but comparison between

treatment and control conditions is necessary to establish causal relationships.

Two groups were involved in the study: (1) the experimental group received mobile-based phonological training, and (2) the control group received pronunciation instruction based on the Communicative Language Teaching (CLT) approach, which involved teacher modeling, repetition drills, and guided speaking activities conducted in the classroom without the use of mobile technology.

Participants

The participants were 60 twelfth-grade students enrolled at SMA Negeri 1 Aceh Besar during the 2024/2025 academic year. Participants were selected using a convenience sampling technique based on classroom availability. The study involved two intact classes that were already established by the school; therefore, no random assignment was conducted. One class, consisting of 30 students, was designated as the experimental group, while the other class, also consisting of 30 students, served as the control group.

All participants were native speakers of Indonesian and had studied English for at least six years through the national curriculum. None of them had received formal training in pronunciation or phonetics in the past six months.

Instruments

Three instruments were used to collect data in this study as follows.

Speech Intelligibility Test (Pretest and Posttest)

The main instrument of this study was a Speech Intelligibility Test administered as both a pretest and posttest. The test consisted of two tasks designed to capture students' intelligibility in controlled and semi-spontaneous academic speaking contexts.

The first task was a reading passage comprising approximately 150–170 words, divided into two short paragraphs. The text was adapted from an academic topic related to environmental issues, such as "The Impact of Plastic Waste on Marine Life." The passage was

carefully selected to include a range of phonological features, including vowel and consonant contrasts (segmental features), as well as stress patterns and intonation (suprasegmental features). The vocabulary level was adjusted to match senior high school proficiency, ensuring that students were familiar with most lexical items while still being challenged to produce accurate pronunciation.

The second task required students to deliver an individual 2–3 minute academic presentation. This was conducted as an individual (not group) performance in front of the class to simulate authentic academic speaking conditions. Students were assigned topics related to general academic themes, such as “The Role of Technology in Education” or “The Importance of Environmental Awareness.” The task aimed to assess students' intelligibility in more spontaneous speech production, including their ability to organize ideas while maintaining clear pronunciation.

All speech samples were audio-recorded using smartphone voice recording applications under standardized conditions. The recordings were conducted in a quiet classroom environment, with each student positioned approximately 20 cm from the recording device to ensure consistent audio quality.

The collected recordings were evaluated using the listener transcription method, in which three independent raters transcribed the students' speech. The raters were EFL lecturers with at least five years of experience in teaching speaking and phonology, and they had prior experience in assessing pronunciation and intelligibility. The percentage of correctly transcribed words was calculated to represent each participant's intelligibility score.

To ensure scoring reliability, an inter-rater reliability analysis was conducted using the Intraclass Correlation Coefficient (ICC). The result showed a high level of agreement among raters (ICC = .931), indicating excellent reliability. This confirms that the scoring procedure was consistent and dependable for subsequent statistical analysis.

Pronunciation Accuracy Rating Scale

A pronunciation accuracy rating scale adapted from established frameworks by Derwing and Munro (2005) was used to assess students' phonological performance. The rubric covered segmental accuracy, suprasegmental features (stress, rhythm, and intonation), and overall speech comprehensibility.

Segmental accuracy was evaluated using a 0–2 scale, where 0 indicates incorrect or unintelligible sound production, 1 indicates partially correct production with noticeable errors, and 2 indicates accurate pronunciation. Suprasegmental features were rated on a 5-point Likert scale ranging from 1 (very poor control of stress and intonation) to 5 (excellent and natural use), reflecting the degree of speech clarity and naturalness. Overall comprehensibility was judged holistically based on how easily the listener could understand the message.

Student Questionnaire

A questionnaire was administered to examine students' motivation, technology readiness, and perceptions toward mobile-assisted phonological training. The instrument aimed to capture learners' affective and behavioral responses to the intervention, complementing the quantitative results of the speech intelligibility test.

The questionnaire consisted of 20 closed-ended items rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). It was adapted from digital learning and Mobile-Assisted Language Learning (MALL) frameworks, particularly focusing on constructs proposed in prior studies such as Pranata (2024). The items were grouped into three main indicators: (1) learning motivation (e.g., interest and engagement in pronunciation practice), (2) technology familiarity (e.g., ease of using mobile applications), and (3) perceived effectiveness (e.g., usefulness of mobile-assisted training in improving pronunciation and confidence).

Prior to the main study, the questionnaire was pilot-tested on a group of 20 students with similar characteristics to ensure clarity and validity. Content validity was established through expert judgment

by two EFL lecturers specializing in language assessment. The reliability analysis showed high internal consistency, with a Cronbach's alpha coefficient of .87, indicating that the instrument was reliable for data collection.

Data Collection and Analysis

Data were collected from three instruments: a speech intelligibility test (pretest and posttest), a pronunciation rating scale, and a student questionnaire. The speech test was administered before and after the treatment to measure changes in students' intelligibility. All speech performances were audio-recorded and evaluated by three trained raters using standardized scoring procedures. The questionnaire was distributed to the experimental group after the intervention to capture students' motivation, technology familiarity, and perceptions of mobile-assisted learning.

All data were analyzed using SPSS. Preliminary analyses were conducted to ensure the assumptions of parametric tests were met. The Shapiro-Wilk test was used to assess the normality of pretest and posttest scores, while the Intraclass Correlation Coefficient (ICC) was calculated to confirm inter-rater reliability.

Descriptive statistics, including means and standard deviations, were computed to summarize the performance of both groups. To examine the effectiveness of the treatment, paired samples t-tests were conducted within each group to identify significant improvements from pretest to posttest. Independent samples t-tests were used to compare posttest scores between the experimental and control groups. Additionally, an ANCOVA was performed using posttest scores as the dependent variable, treatment group as the independent variable, and pretest scores as the covariate to control for initial differences.

The questionnaire data were analyzed using descriptive statistics, including mean scores and percentage distributions, to identify trends in students' responses. The results were interpreted to explain learners' motivation, engagement, and perceptions toward

mobile-assisted phonological training, and were used to support the quantitative findings from the speech intelligibility test.

FINDINGS

This section presents the results of the statistical analyses conducted to examine the effectiveness of mobile-assisted phonological training in improving Indonesian EFL students' speech intelligibility in academic communication. The findings are organized into several subsections, including questionnaire results, normality testing, inter-rater reliability analysis, descriptive statistics, paired samples t-tests, independent samples t-tests, and ANCOVA. Together, these analyses provide evidence regarding students' perceptions of the intervention as well as its impact on their phonological performance and speech intelligibility.

Questionnaire Results

The questionnaire results revealed that students in the experimental group showed positive perceptions toward mobile-assisted phonological training. Overall, the mean scores across all items ranged from 3.98 to 4.35, indicating a high level of agreement.

In terms of learning motivation, students reported increased interest and engagement in pronunciation practice ($M = 4.21$). Regarding technology familiarity, most students found the mobile applications easy to use and helpful for independent learning ($M = 4.08$). Furthermore, in the perceived effectiveness dimension, students agreed that mobile-assisted training improved their pronunciation accuracy and confidence in academic speaking ($M = 4.27$).

These findings suggest that the use of mobile-assisted learning not only enhanced students' phonological performance but also positively influenced their motivation and learning experience.

Normality Test

Before conducting primary statistical analyses, a normality test was performed to determine whether the distribution of scores met the assumptions required for parametric testing. The Shapiro-Wilk

test was chosen because it is suitable for samples of less than 200 participants (Dewaele, 2023). The results of the generalization assessment for both the experimental and control groups, including their pretest and posttest scores, are presented in Table 1.

Table 1.
Tests of Normality

Group	Test	Statistic	df	Sig.
Experimental Pretest	Shapiro-Wilk	.968	30	.472
Experimental Posttest	Shapiro-Wilk	.971	30	.532
Control Pretest	Shapiro-Wilk	.959	30	.291
Control Posttest	Shapiro-Wilk	.964	30	.361

The results of the Shapiro-Wilk normality test showed that all pretest and posttest scores in both the experimental and control groups were normally distributed. As shown in Table 1, the significance values for all datasets ranged from 0.291 to 0.532, all of which exceed the 0.05 threshold. These results confirm that the assumption of normality is met, and allow the use of parametric statistical analysis for subsequent tests.

Inter-Rater Reliability (ICC)

The students' speech intelligibility scores were evaluated by three independent raters, an inter-rater reliability analysis was conducted to ensure consistency in scoring. Intraclass correlation coefficient (ICC) was calculated to determine the degree of agreement between raters. Table 2 shows reliability statistics.

Table 2.
Intraclass Correlation Coefficient

ICC Type	ICC	95% CI Lower	95% CI Upper	F	df1	df2	Sig.
Two-Way Mixed, Absolute Agreement	.931	.901	.957	15.342	59	118	.000

Inter-rater reliability analysis showed a high level of scoring consistency among the three raters. The intraclass correlation coefficient (ICC) gave a value of 0.931 with a significance level of $P < 0.001$, indicating excellent agreement (Chen, 2022). This confirms that the assessment of the pupils' phonological intelligibility was reliable and that the scores can be safely used for subsequent analyses.

Descriptive Statistics

Descriptive statistics were calculated to provide an overview of the students' performance in both groups before and after treatment. Scores for average and standard deviation give a first indication of improvement trends and group differences. These results are presented in Table 3.

Table 3.
Descriptive Statistics

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Experimental	30	62.47	6.31	82.93	5.74
Control	30	61.90	6.52	68.37	6.41

Descriptive statistics revealed that both groups began the study with comparable levels of phonological skills, as indicated by their similar pre-test means. However, significant differences were observed in posttest scores. The experimental group showed significant improvement from 62.47 to 82.93, while the control group showed marginal improvement from 61.90 to 68.37. These patterns suggest that students who received mobile-assisted audio training gained more than those who received traditional instruction.

Paired Samples t-Test

Paired-samples t-tests were conducted to compare pretest and posttest scores to determine whether significant improvements occurred in each group. This analysis helped identify the magnitude of learning gains due to treatment in both the experimental and control groups. The results are summarized in Table 4.

Table 4.
Descriptive Statistics

Group	Pair	Mean Difference	SD	t	Df	Sig. (2-tailed)
Experimental	Posttest - Pretest	20.47	6.12	18.279	29	.000
Control	Posttest - Pretest	6.47	5.21	6.209	29	.000

Paired samples t-test results revealed significant improvements from pretest to posttest within both groups. The experimental group showed a significant gain with a mean difference of 20.47 ($t = 18.279$, $p < 0.001$), indicating a strong effect of mobile-assisted audio training. Meanwhile, the control group showed a statistically significant but very small improvement with a mean difference of 6.47 ($t = 6.209$, $p < .001$). These findings suggest that while both teaching methods contributed to learning progress, the treatment used on the experimental group was significantly more effective (Q. F. Yang, 2020).

Independent Samples t-Test

An independent t-test was performed to compare posttest scores between the experimental and control groups. The purpose of this analysis was to investigate whether pupils who received mobile-assisted audio training outperformed pupils who received traditional teaching. Table 5 shows the results.

Table 5.
Independent Samples Test

Test	Levene's Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error
Posttest Scores	.241	8.762	58	.000	14.57	1.66

Independent samples t-test comparing posttest scores between the two groups showed a statistically significant difference in favor of the experimental group. The experimental group performed better

than the control group with a mean difference of 14.57, and the comparison produced a t-value of 8.762 with $p < .001$. This result confirms that students who participated in mobile-assisted audio instruction achieved significantly higher levels of fluency than those who received traditional instruction.

ANCOVA

To obtain a more accurate estimate of the treatment effect, an ANCOVA analysis was performed using pretest scores as a covariate. This procedure controls for any initial differences between groups, allowing for easier interpretation of post-test score differences. Table 6 shows the ANCOVA results.

Table 6.
ANCOVA results

Source	Type III SS	df	Mean Square	F	Sig.	Partial Eta Squared
Pretest (Covariate)	412.372	1	412.372	19.241	.000	.253
Group	1.934.587	1	1.934.587	90.304	.000	.610
Error	1.242.641	58	21.425			

ANCOVA results further supported the treatment effect by controlling for pre-test differences. After adjusting for baseline scores, the treatment effect remained statistically significant, with the group variable yielding an F value of 90.304 and $p < 0.001$. The partial eta-squared value of 0.610 indicates a large effect size, suggesting that mobile-assisted instruction caused a significant difference in students' post-test comprehension scores (Rais et al., 2025). This strengthens the conclusion that the intervention had a meaningful and strong impact on the pupils' phonological performance.

DISCUSSION

The findings of this study demonstrate the significant effect of mobile-assisted phonology training on improving Indonesian EFL

students' speech intelligibility in academic communication. The results showed that there were significant gains in the experimental group compared to the control group at all levels of analysis, descriptive, inferential and adjusted statistical procedures. These results suggest that integrating mobile technology into phonics teaching can significantly improve students' pronunciation accuracy and communication clarity, especially in educational contexts where accessibility is important (Agustin-Llach, 2022; González-Fernández, 2022; Iravi, 2023; Khonamri, 2020).

The improvement observed in the experimental group can be interpreted within the framework of mobile-assisted language learning (MALL), which emphasizes flexibility, personalization and immediate feedback as key pedagogical advantages. The mobile application used in this study enabled students to engage in repeated practice, receive immediate corrective feedback, and develop awareness of segmental and suprasegmental features of English phonology (Jiang, 2021; Meletiadou, 2021; Nejad, 2021; Sánchez, 2020). This supports previous research suggesting that mobile-based pronunciation tools increase students' self-monitoring and autonomous learning behaviors, leading to measurable improvements in phonological performance. The strong effect size obtained in the ANCOVA further reinforces the idea that mobile technology is not only complementary, but can be a central, effective learning method.

From a theoretical perspective, the results are consistent with phonological acquisition theories that emphasize perceptual salience, corrective feedback, and high-frequency practice as essential components for developing accurate phonological representations. Mobile-assisted training operationalized these concepts by providing repeated information about familiar target sounds, auditory models, and immediate feedback situations to support long-term phonological development (Alam, 2023; Musk, 2022; Shabani, 2020). The significant difference between experimental and control groups confirms claims of interactionist and cognitive load theories: technology-mediated

environments reduce cognitive limitations and increase students' ability to notice gaps between their production and native models.

In contrast, the control group also showed improvement, albeit to a lesser extent. This indicates that traditional pronunciation instruction retains value, but may lack essential features such as individual pacing, opportunities for repeated practice, and rapid pronunciation feedback (Darmawansah, 2022; Liu, 2024; Qin, 2020; W. Yang, 2020). The existence of such a difference highlights an important pedagogical problem: traditional classroom settings, limited by time and teacher effort, cannot provide sufficient depth of phonological practice to produce significant improvements within a limited instructional period.

The results also have meaningful practical implications for EFL teaching in Indonesia. The significant improvement in educational accessibility shows that mobile-assisted audio learning can be effectively integrated into secondary school English programs, especially with the *Merdeka Belajar* (Independent Learning) curriculum, which emphasizes communicative competence, autonomous learning and digital competence. Mobile devices not only improve phonological accuracy, but also help students prepare for academic tasks such as presentations, debates, and scientific discussions, areas where accessibility is critical to achieving communication goals (Feng, 2023; Tsai, 2021; Wang, 2024).

Furthermore, the success of this intervention suggests that teachers can benefit from mobile applications to supplement classroom instruction, particularly for pronunciation practice that requires intensive repetition and individualized feedback. This is particularly relevant in Indonesian classrooms, where large class sizes often limit opportunities for personalized guidance.

This interpretation is further supported by the questionnaire findings, which showed that students reported high levels of motivation, ease of use, and perceived effectiveness of mobile-assisted phonological training. These positive perceptions indicate that mobile

learning environments can enhance learner engagement and autonomy.

These findings are consistent with previous studies, such as Pratiwi (2020) and Nasution et al. (2023), which reported that mobile-assisted language learning promotes learner motivation and active participation. From a theoretical perspective, this aligns with constructivist learning theory, which emphasizes active engagement and self-directed learning, as well as interactionist perspectives highlighting the role of feedback and repeated exposure in language acquisition.

Therefore, incorporating mobile applications not only addresses instructional constraints but also supports more effective and learner-centered pronunciation development.

On a broader level, the findings support a growing body of literature highlighting the role of technology in improving language learning outcomes. They confirm the claim that digital tools, when properly designed and implemented, can promote higher-order language skills and promote learner autonomy (Derakhshani, 2021; Kaatari, 2023; Luquin, 2021). The results also challenge traditional assumptions that pronunciation training is too complex to be supported by automated systems, and instead show that mobile-based tools can effectively guide learners towards better intelligibility.

CONCLUSION

This study provides empirical evidence that mobile-assisted phonological training significantly improves Indonesian EFL students' speech intelligibility in academic communication. Students who received mobile-based audio instruction showed greater improvements in pronunciation accuracy and intelligibility than those in the control group, as confirmed by the results of t-tests and ANCOVA.

The findings suggest that mobile-assisted learning is an effective approach to support pronunciation development by offering repeated practice, immediate feedback, and flexible learning

opportunities. These advantages make it particularly relevant for addressing common instructional challenges in large classrooms and align with current educational goals emphasizing learner autonomy and digital competence. Theoretically, the results support phonological acquisition and interactionist perspectives, highlighting the importance of feedback, salience, and sustained practice in developing intelligible speech.

However, this study has several limitations. The sample was limited to one school with a relatively small number of participants, which may restrict the generalizability of the findings. In addition, the study focused on short-term intervention effects and did not examine long-term retention of pronunciation improvement. Future research is recommended to explore broader populations, longer intervention periods, and the application of mobile-assisted learning to other aspects of academic speaking.

DECLARATION OF AI AND AI-ASSISTED TECHNOLOGIES

The authors claim that artificial intelligence (Grammarly) and AI-assisted technologies are only used for language enhancement, including grammar correction, grammar checking, and improving clarity of expression. These instruments generated no part of the scientific content, research ideas, data analysis, interpretation, or conclusions presented in this manuscript. All intellectual contributions, research design, data collection, analyzes and final interpretations are the original work of the authors. The authors take full responsibility for the accuracy, integrity and originality of the manuscript.

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