Comparative effects of facial massage and oral motor exercises on sialorrhea in individuals with Parkinson's disease

Efeitos comparativos da massagem facial e dos exercícios motores orais na sialorréia em indivíduos com doença de Parkinson

Jessie J
Dhanusia S*
Prathap Suganthirababu
Suriya N
Priyadharshini K
Vanitha J
Vignesh Srinivasan
Sathya Siva

Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India

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***Correspondence:** dhanusiasuresh1798@gmail.com

Abstract

Introduction: Parkinson's disease (PD) is a complex neurodegenerative disorder often accompanied by sialorrhea, caused by hypersalivation or impaired saliva clearance. Although motor symptoms have been widely studied, non-motor features like sialorrhea remain underrecognized. **Objective:** To compare the effects of facial massage and oral motor exercises on sialorrhea in individuals with PD. **Methods:** Based on inclusion and exclusion criteria, 60 participants were randomly subjected to two groups: group A with facial massage (n = 30) and group B with oral motor exercises (n = 30). Demographic data were collected, drooling severity was assessed using the Drooling Severity and Frequency Scale (DSFS) and Drooling Rating Scale (DRS). Interventions were administered four times weekly for eight weeks. **Results:** Post-test DSFS mean and standard deviation values were 6.37 ± 0.89 for group A and 2.80 ± 0.89 for group B. DRS values were 2.07 ± 0.52 for group A and 0.83 ± 0.59 for group B. A statistically significant difference was found between groups ($p < 0.001$), indicating superior outcomes for oral motor exercises. **Conclusion:** Both interventions led to significant physiological improvements, including enhanced swallowing efficiency and saliva clearance. However, oral motor exercises demonstrated a greater reduction in hypersalivation and better drooling control than facial massage. This study highlights the effectiveness of oral motor exercises in managing sialorrhea in PD patients.

Keywords: Hypersalivation. Quality of life. Swallowing. Massage.

Resumo

Introdução: *A doença de Parkinson (DP) é um distúrbio neurodegenerativo complexo frequentemente acompanhado de sialorreia, causada por hipersalivação ou comprometimento da eliminação da saliva. Embora os sintomas motores tenham sido amplamente estudados, características não motoras como a sialorreia continuam sub-reconhecidas.* ***Objetivo:*** *Comparar os efeitos da massagem facial e dos exercícios motores orais sobre a sialorreia em indivíduos com DP.* ***Métodos:*** *Com base nos critérios de inclusão e exclusão, 60 participantes foram aleatoriamente divididos em dois grupos: grupo A, com massagem facial (n = 30); e grupo B, com exercícios motores orais (n = 30). Dados demográficos foram coletados e a gravidade da salivação foi avaliada por meio da Escala de Gravidade e Frequência da Salivação (EGFS) e da Escala de Avaliação da Salivação (EAS). As intervenções foram administradas quatro vezes por semana durante oito semanas.* ***Resultados:*** *Os valores médios e desvio-padrão do EGFS pós-teste foram de 6,37 ± 0,89 para o grupo A e de 2,80 ± 0,89 para o grupo B. Os valores de EAS foram de 2,07 ± 0,52 para o grupo A e de 0,83 ± 0,59 para o grupo B. Uma diferença estatisticamente significativa foi encontrada entre os grupos (p < 0,001), indicando resultados superiores para exercícios motores orais.* ***Conclusão:*** *Ambas as intervenções levaram a melhorias fisiológicas significativas, incluindo maior eficiência de deglutição e depuração de saliva. Os exercícios motores orais, no enteanto, demonstraram uma maior redução na hipersalivação e melhor controle da salivação do que a massagem facial. Este estudo destaca a eficácia dos exercícios motores orais no tratamento da sialorreia em pacientes com DP.*

Palavras-chave: *Hipersalivação. Qualidade de vida. Deglutição. Massagem.*

Introduction

Parkinson's disease (PD) is a complex neurological illness that progresses over time and is marked by rigidity, resting tremors, and slowness of movement. As the condition progresses, individuals get to experience adverse motor and non-motor symptoms.[1-3] Dopaminergic neuronal loss in the substantia nigra and cardinal motor traits associated with Lewy bodies have long been used to differentiate PD from parkinsonism.[4,5] The primary etiology of idiopathic PD is unknown, although risk factors such as family history, pollutants, aging and chemical agents are linked to the condition.[6,7] PD is found most prevalent among older age people and affects about 1% of adults older than the age of sixty.[8]

Sialorrhea, or excessive drooling, refers to the overflow of saliva beyond the lips and is frequently observed in individuals with PD.[9] It may arise from two main mechanisms: hypersalivation and impaired saliva elimination.[10] Hypersalivation occurs due to incoordination of the oropharyngeal muscles, which reduces the frequency of swallowing and makes saliva clearance difficult. The swallowing reflex and oral motor control are crucial for maintaining normal salivary balance; when these processes are compromised, excess saliva accumulates in the oral cavity.[11] On the other hand, problems with saliva elimination are commonly associated with oropharyngeal bradykinesia, poor head and lip control, disorganized tongue movements, persistent open-mouth posture, and diminished tactile sensations, all of which contribute to increased salivary pooling.[12] Drooling can further lead to complications such as aspiration pneumonia, skin infections, mal-odor, social withdrawal, and embarrassment, greatly reducing quality of life.[13]

Despite being a common non-motor symptom, sialorrhea in PD has often been underrecognized; however, many patients consider it one of the most disabling symptoms. It is particularly prevalent in advanced stages of PD, affecting up to 80% of patients, regardless of ethnicity. About half of individuals with early-stage PD experience drooling, and over one-third perceive it as a significant problem.[14,15] As the disease advances, oral functions become increasingly difficult, especially for those wearing complete dentures.[16]

According to the clinical guidelines of the American Academy of Neurology for the management of sialorrhea, treatment can be approached through conservative measures such as swallowing therapy and elastic therapeutic taping, followed by pharmacological interventions. Anticholinergic agents are recommended as the first-line drugs, while botulinum toxin injections are suggested to effectively reduce drooling.[17-19] The majority of studies assessing speech therapy for managing sialorrhea demonstrated a reduction in drooling, but no long-term effects were observed, according to a pooled review of several trials.[20]

Facial massage (FM) for sialorrhea in PD involves using rhythmic movements and gentle pressure on the muscles surrounding the face, jaw, and neck to increase muscular tone, enhance swallowing reflexes, and promote re-

laxation. FM has less serious side effects than pharmaceutical therapies, which makes it a viable choice for people looking for non-invasive ways to treat sialorrhea.[21]

The purpose of oral motor exercises (OME) is to improve the function, strength, and coordination of the muscles used for mouth clearing, salivation control, and swallowing. These exercises are believed to increase muscular tone, enhance motor coordination, and lessen saliva pooling in the oral cavity.[22,23]

Although FM and OME are frequently recommended as non-invasive strategies for managing sialorrhea in PD, existing studies are limited, methodologically inconsistent, and often report conflicting results. To date, only a few studies have evaluated about these interventions[21-23] and direct head-to-head comparisons between FM and OME are almost absent. Given that sialorrhea affects up to 80% of patients, addressing this gap is essential to reduce aspiration risk, prevent social isolation, and improve quality of life. Identifying cost-effective, non-pharmacological, evidence-based therapies is particularly important for individuals with advanced disease or contraindications to anticholinergic drugs and botulinum toxin injections. However, the lack of robust comparative evidence between FM and OME restricts physiotherapists and other clinicians from making informed decisions about structured, non-invasive interventions in daily practice. Therefore, the present study aimed to compare the relative effectiveness of FM and OME on sialorrhea in PD, explore possible underlying mechanisms, and provide guidance for clinical application.

Methods

A comparative study was conducted among 60 individuals who volunteered to participate from a private setting based on the eligibility criteria. Every individual participant belonged to the South Indian ethnicity. The participants were divided into two groups through simple random sampling performed using lottery method. Each participant who met the inclusion and exclusion criteria were assigned with unique serial numbers. The random allocation sequence was prepared by an independent researcher who was not involved in the treatment procedure. Each group was placed in an opaque, sealed and sequential numbered envelopes. During the allocation process, the envelopes were opened in sequence. The participants were blinded to the allocation concealment.

Initially 126 subjects volunteered to participate in the study (Figure 1), but the sample size came down to 60 due to participants not meeting inclusion or declining to participate. Sample size was calculated using G* power assuming moderate effect size of 0.5, which is commonly used in similar studies. The calculation used a significance level (α) of 0.05, power of 95% and considering the 10% potential dropouts and variabilities.

The study was done in accordance with the ethical committee on human experimentation of Institutional Scientific Review Board on 381/07/2024/ISRB/UGSR/SCPT. The study included individuals with PD having baseline characteristics of a score greater than 3 in the Hoehn and Yahr scale, aged 60 to 79, experiencing sialorrhea (score > 6 on the Drooling Severity and Frequency Scale - DSFS), decreased jaw ROM assessed using goniometer and swallowing difficulty (score < 3 in Dysphagia Severity and Outcome Scale). Every individual was in a stable dosage of levodopa and carbidopa and they were not allowed to change the dosage of the medicines during the course of this study. Exclusion criteria included other neurodegenerative or neurological conditions, recent facial trauma, cognitive impairment, open wounds, skin infections, tumours, or facial surgeries.

The therapist was trained on the study protocol, evaluation methods, and therapy approaches prior to the trial. The primary physiotherapist's weekly supervision reduced variability and improved the reliability of results by guaranteeing corrective feedback, consistency in the administration of interventions, and adherence to ethical standards.

Study procedure

A treatment procedure of providing facial massage and oral motor exercises was conducted for a period of eight weeks. All these procedures were carried out by trained physiotherapists, and it goes as follows:

Group A (Facial massage group): Participants in the FM group received facial massage three times daily, four days per week, for eight weeks. Each session lasted approximately 15–20 minutes. Subjects were positioned upright with the head slightly tilted forward to minimize saliva pooling. The protocol involved the application of light moisturizer to reduce friction, followed by standardized massage techniques. Using the fingertips, the therapist applied gentle circular pressure to the jaw, lips, and cheeks, progressing to effleurage strokes with the palms directed upward and outward along the forehead,

cheeks, and neck. The sequence aimed to improve orofacial muscle tone, facilitate salivary clearance, and promote relaxation. All sessions were delivered by a trained physiotherapist following a uniform protocol to ensure consistency. This approach was adapted from therapeutic massage protocols reported in neurological rehabilitation.[21,24]

Group B (Oral motor exercises group): Participants in the OME group performed structured oromotor exercises three times daily, four days per week, for 8 weeks. Each session lasted approximately 15–20 minutes, with individual exercises repeated 10–15 times. Patients were instructed to gently close their lips as tightly as possible and hold for 5-10 seconds (Active lip closure); to stretch their lips as wide as possible (as if smiling) and hold for 5-10 seconds (Lip stretching); to stick their tongue out as far as possible and hold for 5 seconds, then to push the tongue against the roof of the mouth for 5 seconds (Tongue push-ups); to open their mouth as wide as possible and hold for 5 seconds, then close the mouth tightly and hold for 5 seconds (Jaw opening and closing); to simulate chewing by moving their jaw up and down in a chewing motion without food in the mouth (Chewing simulation). These exercises were designed to strengthen orofacial muscles, enhance neuromuscular coordination, and improve swallowing efficiency for saliva clearance. Participants were instructed to perform the exercises in front of a mirror to facilitate self-monitoring, and adherence was supervised weekly by the therapist. This protocol was based on established oromotor rehabilitation methods for dysphagia and facial dysfunction.[25,26]

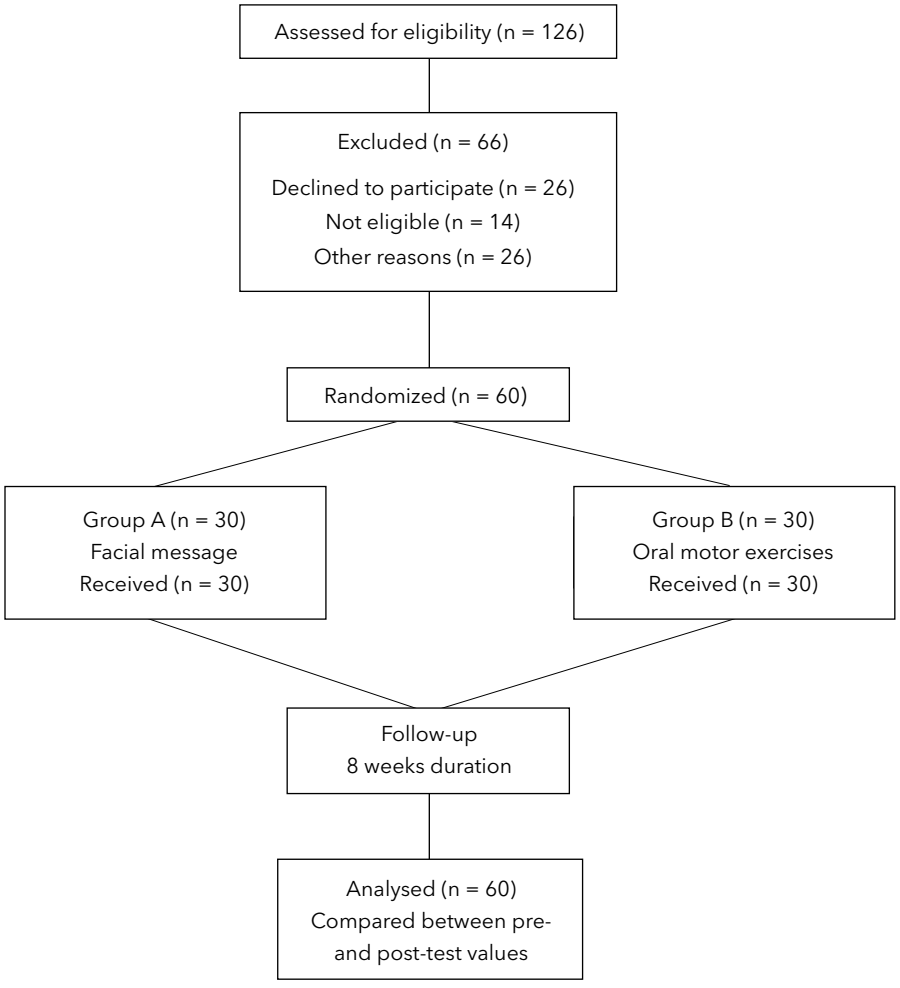

Figure 1 - Consort flow chart diagram.

Outcome measures

The DSFS is a semi-quantitative tool designed to assess drooling, originally developed for individuals with PD. It demonstrates strong reliability, with inter-rater reliability ranging from 0.85 to 0.95 and intra-rater reliability between 0.88 and 0.97. Its construct validity falls between 0.70 and 0.85, indicating its effectiveness in measuring sialorrhea. The scale categorizes drooling severity based on scores: 2–3 signifies mild drooling, 4–5 indicates moderate drooling, 6–7 represents severe drooling, and 8–9 reflects very severe drooling. This structured assessment aids in evaluating and monitoring the progression of sialorrhea in PD patients.[27]

The Drooling Rating Scale (DRS) was specifically developed to assess sialorrhea in individuals with PD. It has been validated with a reliability score of 0.85 and a validity score of 0.69, ensuring its effectiveness in measuring drooling severity. The scale categorizes drooling into four levels: 0 indicates no excess saliva, while a score of 1 represents the presence of excess saliva in the mouth without external drooling. A score of 2 corresponds to mild to moderate drooling, and a score of 3 signifies continuous drooling. This classification system helps in objectively evaluating and monitoring the severity of sialorrhea in PD patients.[28,29]

Data analysis

The data analysis for each group was done using Statistical Package for the Social Sciences software. The normality test was assessed using Shapiro-Wilk test. As data was normally distributed, parametric test was applied. Paired T test was used to calculate the pre and post-test values within the groups and unpaired T test was used to calculate the post-test values between the groups. Additionally, Cohen's d effect size was calculated to complement the p-value.

Results

Baseline characteristics were comparable between groups, with no significant differences observed (Table 1). Both groups demonstrated significant reductions in drooling severity and frequency after the 8-week intervention ($p < 0.001$ within groups). Between-group comparisons indicated that OME produced greater improments than FM, with large effect sizes (Cohen's $d > 0.8$), confirming the clinical as well as statistical relevance of the findings. Detailed mean scores, standard deviations, p-values, and effect sizes are presented in Tables 2 and 3.

Table 1 - Baseline characteristics of patients

Variable	Group A	Group B	p- value
Age	66.7 ± 1.85	66.26 ± 1.83	0.35
Gender (M/F)	18/12	16/14	0.55
BMI	21.06 ± 1.14	20.96 ± 1.27	0.74
HY scale	3.53 ± 0.73	3.43 ± 0.56	0.55
PD duration	6.06 ± 1.04	5.83 ± 1.26	0.44

Note: M = male; F = female; BMI = body mass index; HY = Hoehn and Yahr; PD = Parkinson´s disease. Values expressed as mean ± standard deviation, except for gender.

Table 2 - Pre- and post-test values of DSFS and DRS scales in groups A (n = 30) and B (n = 30)

Groups	Pre-test*	Post-test*	T value	p-value
DSFS				
Group A	7.74 ± 0.96	6.37 ± 0.89	4.17	< 0.001
Group B	7.30 ± 1.05	2.80 ± 0.88	17.88	< 0.001
DRS				
Group A	2.47 ± 0.50	2.07 ± 0.52	3.01	< 0.001
Group B	2.57 ± 0.50	0.83 ± 0.59	12.25	< 0.001

Note: DSFS = Drooling Severity and Frequency Scale; DRS = Drooling Rating Scale. *Mean ± standard deviation.

Table 3 - Comparison of post-test result values of DSFS and DRS scales in groups A (n = 30) and B (n = 30)

Groups	Mean	SD	T value	p-value	Cohen's
DSFS					
Group A	6.37	0.89	14.40	< 0.001	0.98
Group B	2.80	0.89	14.40	< 0.001	1.33
DRS					
Group A	2.07	0.52	9.28	< 0.001	0.56
Group B	0.83	0.59	9.28	< 0.001	0.69

Note: DSFS = Drooling Severity and Frequency Scale; DRS = Drooling Rating Scale; SD = standard deviation; Cohen´s d effect size. *Mean ± SD.

Discussion

This study aimed to evaluate the effects of OME and FM on reducing sialorrhea in PD. Both interventions demonstrated benefit, though OME produced a greater reduction in drooling severity and frequency.

The underlying mechanisms may explain these differences. OME involves repetitive, task-specific activation of lip, tongue, and jaw musculature, which strengthens orofacial muscles, improves swallowing coordination, and facilitates more effective saliva clearance. FM, by contrast, promotes relaxation, improves blood circulation, and may enhance lymphatic drainage, but its shorter duration and lower repetition intensity may contribute to compatively smaller effects.

The inability to regulate saliva due to tight facial and oral muscles in PD frequently results in discomfort and drooling. According to Marin et al.,[21] regular facial massage can help relax these muscles, thereby improving swallowing and salivary control. These results corroborate our findings, although their study presents methodological weakness, including an unclear control group, an undefined sample size, and inadequate blinding. Similarly, Santiago et al.[30] discovered that massage may improve blood circulation and lymphatic drainage in the face and neck, supporting oral health and facilitating saliva clearance. Despite having a strong physiological foundation and therapeutic applicability, this study's short-comings were a brief duration, little follow-up, few outcome measurements, and no direct saliva control data.

As reported by our subjects, OME improved the chewing muscles and helped to manage sialorrhea. Our findings are consistent with those of Sığan et al.,[31] who demonstrated that OME is effective in controlling drooling in cerebral palsy by correcting posture, improving jaw and lip closure, improving tongue control, reducing tongue thrust, normalizing muscle tone, and restoring facial and oral sensation. The study's large sample size, randomized design, and use of validated instruments demonstrated a definite improvement in feeding and oral motor skills. However, it lacked long-term follow-up, thorough drooling data, appropriate stratification, and complete blinding, all of which restrict generalizability. OME strengthens lip closure, increases the frequency of swallowing, and improves oral and pharyngeal muscle coordination, all of which contribute to better saliva management.[32]

Consistent with Gupta A et al.[33] study in 2022, incorporating OME into a comprehensive treatment plan can reduce drooling episodes and improve quality of life in individuals with sialorrhea. However, the study's lack of follow-up and varied intervention delivery introduced bias.

The current findings are further supported by more recent motor rehabilitation research in PD. While Cocks et al.[34] showed that expiratory muscular strength training decreased drooling and improved swallowing efficiency, although a small sample size, high dropout rate and absence of control group weakened the reliability of the results. Baram et al.[35] revealed that orofacial physiotherapy improved oral motor function and quality of life, meanwhile delayed intervention, lack of objective measures and limited subject selection affected the results; however, these findings demonstrated how physiotherapy-based rehabilitation is increasingly being used to treat both motor and non-motor symptoms of PD. The need for more thorough comparative research is highlighted by the fact that even these recent trials have methodological heterogeneity. To minimize such limitations, the present study employed stronger methodological rigor, including close supervision by qualified physiotherapists, standardized intervention procedures, validated outcome measures, and single-blinded randomization. These measures strengthen the validity and clinical relevance of the observed improvements.

Our findings showed a clear reduction in drooling severity after implementing an OME program. This intervention improved orofacial muscle strength, lip closure, tongue movement, and swallowing coordination — all essential for better saliva control. Although FM was also found to be an effective intervention, its impact was less significant compared to OME. In group A, the effect sizes for DSFS and DRS were 0.98 and 0.56, respectively, while in group B they were 1.33 and 0.69. These results suggest that incorporating OME into rehabilitation programs offers robust approach in reducing drooling severity in PD. It emphasizes clinical relevance beyond statistical significance.

In clinical practice, oral motor exercises can be taught to patients and caregivers as systematic exercise concentrating lip, tongue, and swallowing. These exercises can be incorporated into regular therapy sessions and reinforced as part of daily home programs under close supervision. It can offer a non-invasive and cost-effective alternative to medical and surgical treatments for sialorrhea.

However, there are practical barriers such as patient exhaustion, noncompliance, therapist time constraints, and cognitive decline. The lack of standardized procedures and contradicting efficacy data makes continuous application difficult.

Addressing these barriers requires standardized therapist training, caregiver participation, adherence reminders, frequent follow-up, and more solid data from larger clinical trials to increase confidence. Clinically, implying OME helps patient by lowering the intensity of drooling, improving oral hygiene, enhancing swallowing safety, and encouraging improved speech and social interaction, thereby improving overall quality of life.

Limitation and recommendation

This study has some important limitations. The small sample size (n = 60) and recruitment from a single, homogeneous South Indian population substantially limit the generalizability of the findings, and results may not directly apply to broader or more diverse PD populations. The absence of double blinding and the lack of long-term follow-up may also have introduced bias. Furthermore, the study did not assess variability across age groups, disease stages, or the influence of antiparkinsonian medications and psychological factors, all of which could alter salivary control. Importantly, the absence of a non-intervention control group restricts comparison with the natural progression of sialorrhea in PD, making it difficult to determine whether improvements were solely due to the interventions. In addition, the intervention volumes were not fully equivalent: both FM and OME were delivered three times daily, but OME required multiple repetitions per session while FM was shorter. This reflects clinical practice patterns but may have influenced comparative effectiveness.

Finally, while the study received ethical approval (381/07/2024/ISRB/UGSR/SCPT), it was not prospectively registered in a public trial registry, which reduces transparency and limits external verification. Future studies should address these issues by adopting multicentre designs with larger and more diverse samples, including appropriate non-intervention control groups, applying standardized intervention intensities, ensuring prospective trial registration, and using objective markers such as salivary flow rate to improve methodological rigor and generalizability.

Conclusion

The results of our study indicate that both OME and FM reduce salivary frequency and severity of drooling. However, OME proved to be more effective than FM by increasing oral motor strength and reducing salivary secretion, facilitating better saliva management. In contrast, FM primarily offers temporary muscle relaxation but does not improve swallowing function when compared to OME. This evidence will support physiotherapist to form a structured, non-pharmacological protocol in managing sialorrhea in PD and will enhance the clinical decision making. These implications are applicable for the individuals with moderate PD above 60 years of age and who are under stable medication. Based on these results, both interventions contribute to minimizing functional impairment and managing sialorrhea, though OME offers a more substantial and lasting impact.

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Authors' contributions

JJ and SN were involved in data collection and intervention. DS conceived and designed the study and drafted the manuscript. PS and VS contributed to data analysis and interpretation. PK and VJ assisted with literature review and manuscript revision. SS supervised the study and critically reviewed the manuscript. All authors approved the final manuscript.

Data availability statement

Research data are available from the corresponding author upon reasonable request.

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