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(Research Article)

Acute effect of continuous 10 second passive stretching on piriformis flexibility

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Abstract

Background: Piriformis syndrome (PS) is a neuromuscular condition characterized by buttock pain and sciatic nerve irritation, often exacerbated by sitting or lower limb activity. Conservative interventions, including stretching, are commonly used to manage symptoms, but evidence on the acute effectiveness of short-duration passive stretching is limited.

Objective: This study aimed to evaluate the immediate effects of a 10-second passive stretching intervention on piriformis muscle flexibility and associated pain in adults aged 20–45 years.

Methods: A total of 20 participants (13 males, 7 females) with piriformis tightness and lower back discomfort were recruited. Pre- and post-intervention assessments of pain were performed using the Visual Analogue Scale (VAS). Participants were stratified by age (20–35 and 35–45 years) and gender to examine subgroup responses. Data were analysed for overall pain reduction, age- and gender-specific effects, and improvements in muscle flexibility.

Results: The intervention significantly reduced pain, with mean VAS scores decreasing from 5.45 pre-intervention to 2.80 post-intervention (mean reduction: 2.65). Both age groups demonstrated comparable improvements (20–35 years: 2.62; 35–45 years: 2.67), and both genders benefited, with slightly higher reductions in males (2.69) compared to females (2.57). Participants with higher baseline pain also experienced meaningful improvements. Advanced visualization techniques, including KDE and violin plots, highlighted pain distribution and intervention efficacy.

Conclusion: A 10-second passive stretching intervention effectively reduces pain and improves piriformis muscle flexibility across age and gender groups. These findings support its potential clinical application for acute management of piriformis syndrome. However, small sample size and gender imbalance suggest that larger, more balanced studies are needed to confirm and generalize these results.

Keywords: Piriformis Syndrome; Passive Stretching; Visual Analogue Scale; Pain Reduction; Muscle Flexibility; Acute Intervention

1. Introduction

Piriformis syndrome is a condition characterized by inflammation of the sciatic nerve caused by abnormal conditions in the piriformis muscle (Adiyatma et al, 2022). It is characterized by buttock pain, potentially radiating to the leg, worsened by sitting or lower limb activity. Symptoms may include tenderness of the piriformis muscle, leg length discrepancy, and pain during resisted hip abduction, without low back issues (Agrawal et al., 2023). It is causing symptoms like buttock pain and tenderness. It is often diagnosed as a myofascial condition, with conservative management being the initial treatment approach (Lo et al., 2024). Piriformis syndrome is an entrapment neuropathy

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caused by the compression of the sciatic nerve by the piriformis muscle, leading to pain, numbness, and weakness in the sciatic nerve distribution, often following trauma or repetitive hip motions (Waldman et al., 2024). Piriformis syndrome (PS) is a condition causing deep gluteal pain, often confused with spinal sciatica. It affects 0.3% to 36% of patients with low back pain, with treatment options including analgesics, therapeutic exercises, and, in severe cases, surgery (Siddiq et al., 2023). It occurs due to excessive contraction of the piriformis muscle, causing inflammation of the sciatic nerve and affecting approximately 2.4 million individuals annually, predominantly women in their 4th and 5th decades of life (Adiyatma et al, 2022). Diagnosis of piriformis syndrome is challenging, often relying on clinical signs and excluding other conditions and treatment includes physical therapy and injections. (Lo et al., 2024; Biggi et al., 2011). Piriformis syndrome (PS) diagnosis is complex due to its overlapping symptoms with other conditions. Several diagnostic tests have been proposed, each with varying degrees of reliability and specificity. The following sections outline the primary diagnostic methods for PS (Chen and Nizar, 2013; Gebregiorigis and Amha, 2024). The diagnosis of piriformis syndrome primarily aims to exclude other causes of sciatica, as there are no precisely confirmed diagnostic criteria. Various diagnostic tests and imaging studies are available, but their effectiveness can vary based on individual cases (Cholewa et la., 2024). The modified Flexion Adduction Internal Rotation (FAIR) test, which combines the Lasegue sign and FAIR test, is used for diagnosing piriformis syndrome. Confirmation is achieved through piriformis muscle injection, which serves both diagnostic and therapeutic purposes (Chen and Nizar, 2013). Diagnostic musculoskeletal ultrasound (MSK US) is a non-invasive, cost-effective test for evaluating piriformis syndrome, providing dynamic, real-time imaging of the piriformis muscle and adjacent structures, aiding in accurate diagnosis when correlated with clinical symptoms and other tests (Manske et al, 2024). The Freiberg test is a predictive diagnostic test for piriformis syndrome (PS). However, diagnosis should be confirmed by tenderness of the piriformis muscle and a local injection, as many other pathologies can be incidentally detected radiographically (Yürük et al., 2024). The Number Rating Pain Scale (NRPS) and the Functional Performance Lower Extremity Scale (FPLES) are essential tools in pain assessment and functional evaluation. The NRPS is a unidimensional scale that quantifies pain intensity on a 0-10 scale, widely recognized for its reliability and validity across various populations, including those with spinal cord injuries (Bryce et al., 2007). In contrast, the FPLES is a multidimensional tool that assesses functional performance, particularly in lower extremities, providing a broader understanding of how pain impacts daily activities, and it allows for a comprehensive evaluation of pain's impact on functional activities, which is crucial for treatment planning (Safran et al., 2024). The sciatic nerve, implicated in Piriformis syndrome, originates from the L4 to S3 nerve roots, which converge anterior to the lateral sacrum a location that can influence its susceptibility to entrapment at the piriformis muscle (Waldman et al., 2024). This nerve emerges from the lumbosacral plexus and carries fibers primarily from L4 to S1, contributing to the varied symptomatology of the syndrome. The piriformis muscle itself receives innervation mainly from the S1 and S2 spinal segments, with occasional input from L5 (Mitra et al., 2024). The primary aim of this study is to determine the acute effect of continuous 10-second passive stretching on the flexibility of the piriformis muscle. This research focuses on evaluating whether a short-duration passive stretch can produce immediate improvements in muscle flexibility and a reduction in associated pain or discomfort. The objectives include assessing the baseline flexibility of the piriformis muscle, implementing a standardized 10-second passive stretching intervention, and measuring any changes in muscle flexibility and pain score following the intervention. By comparing pre- and post-intervention outcomes, the study seeks to understand the potential benefits of brief passive stretching as a quick and effective method for relieving piriformis tightness and associated symptoms. This could have practical implications for physiotherapy and rehabilitation strategies targeting lower back or gluteal pain related to piriformis syndrome.

2. Materials and Methodology

Following ethical approval from the Institutional Ethics Committee of Krishna Institute of Medical Sciences, Deemed to Be University, Karad, a cross-sectional study was conducted to evaluate the acute effect of a 10-second passive stretching intervention on piriformis muscle flexibility. The study was carried out in Karad, with data collection conducted in a clinical setting under the supervision of trained professionals.

Participants were recruited using a convenient sampling technique. The inclusion criteria consisted of male and female sub-elite employees between the ages of 20 to 45 years who had experienced lower back discomfort within the past three months. Individuals with recent lower back trauma, prior surgery, or diagnosed neurological or musculoskeletal disorders were excluded from the study.

Eligible participants underwent an initial assessment to identify piriformis muscle tightness and associated symptoms. Clinical evaluation included tests for muscle flexibility and provocation of symptoms related to piriformis dysfunction. Pain intensity was measured using the Visual Analogue Scale (VAS) as a primary outcome measure, along with clinical assessment of flexibility before and after the intervention.

The intervention involved administering a 10-second continuous passive stretch specifically targeting the piriformis muscle. Post-intervention evaluations were conducted immediately to assess any acute changes in muscle flexibility and pain perception. The collected data were used to determine the short-term effectiveness of passive stretching as a therapeutic approach for improving piriformis flexibility.

3. Results

The study included a total of 20 participants, comprising 13 males and 7 females, resulting in a male-to-female ratio of 1.86:1. This indicates a higher representation of male participants within the study cohort, which may influence gender-based comparisons. **Fig 1** presents a pie chart illustrating the distribution of male and female participants.

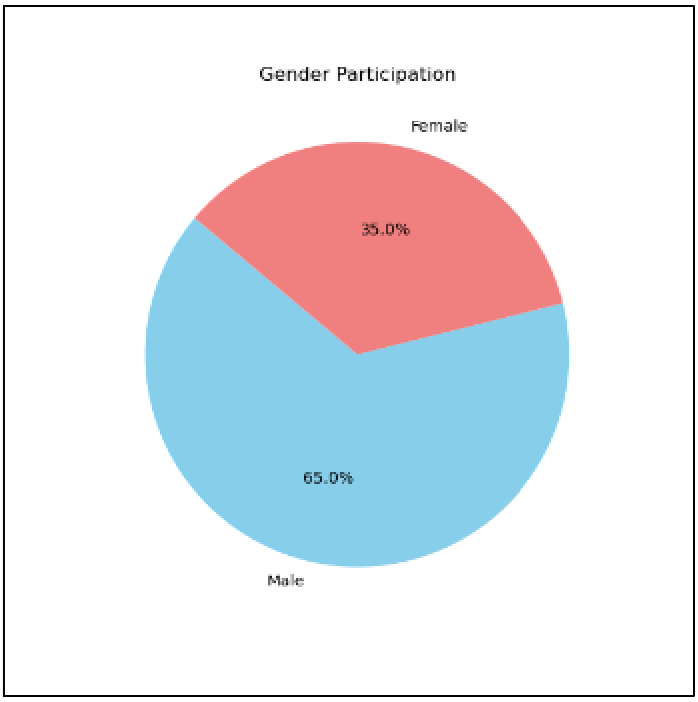

Figure 1 The Distribution of Male and female participants in the study

3.1. Pre-Intervention Pain Severity

Prior to the intervention, participants in the 35–45 age group reported slightly higher baseline pain compared to those in the 20–35 age group. Similarly, male participants exhibited higher pre-intervention pain scores relative to females. Despite these differences in baseline severity, the intervention produced meaningful reductions in pain across all groups, demonstrating its effectiveness irrespective of initial pain levels.

3.2. Pain Scores

Baseline analysis revealed a mean pre-intervention pain score of 5.45. Following the intervention, the mean post-intervention pain score decreased to 2.80, corresponding to an average reduction of 2.65 points on the Visual Analogue Scale (VAS). These results indicate that the intervention was effective in alleviating pain across the study population. **Fig 2** illustrates the distribution of pre- and post-intervention pain scores using a kernel density estimate, highlighting the overall reduction in pain levels.

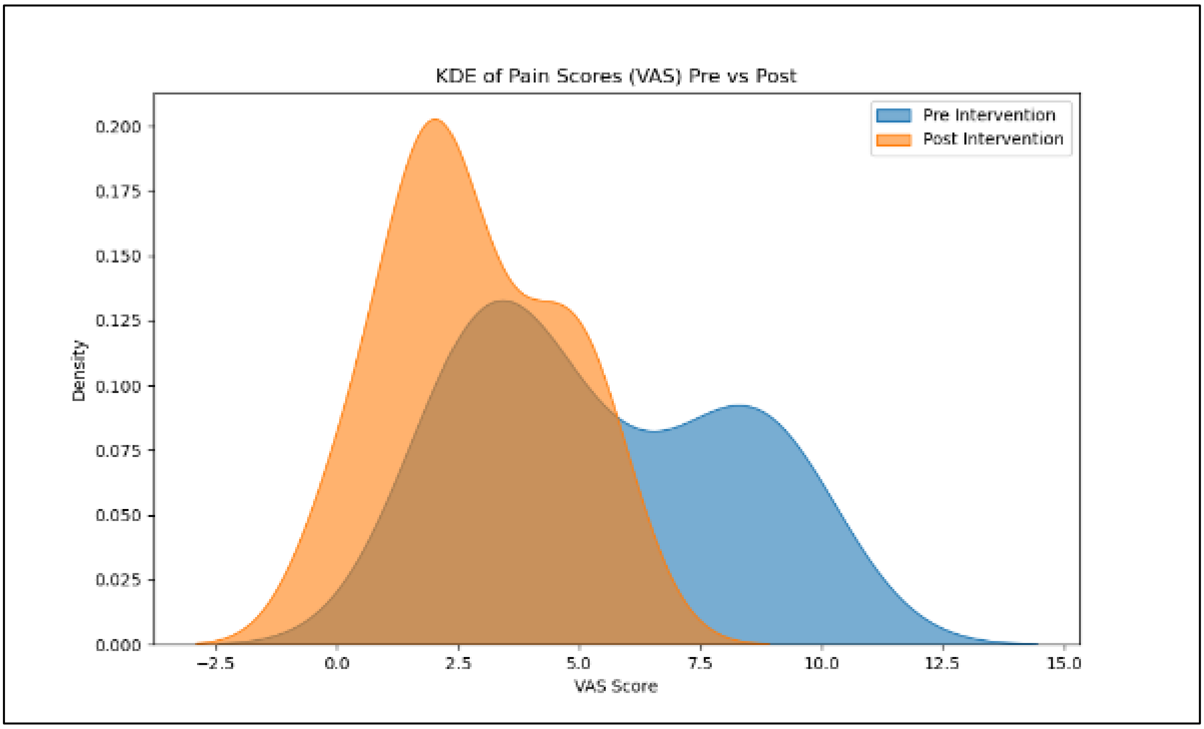

Figure 2 The distribution of pre- and post-intervention pain scores using a kernel density estimate

3.3. Pain Reduction by Age Group

Participants were stratified into two age groups: 20–35 years and 35–45 years. The 20–35 age group exhibited an average VAS reduction of 2.62 points, whereas the 35–45 age group demonstrated a slightly higher mean reduction of 2.67 points. This suggests that the intervention was effective across both age groups. **Fig 3** displays a violin plot overlaid with a swarm plot, depicting the distribution and variability of VAS improvements within each age group.

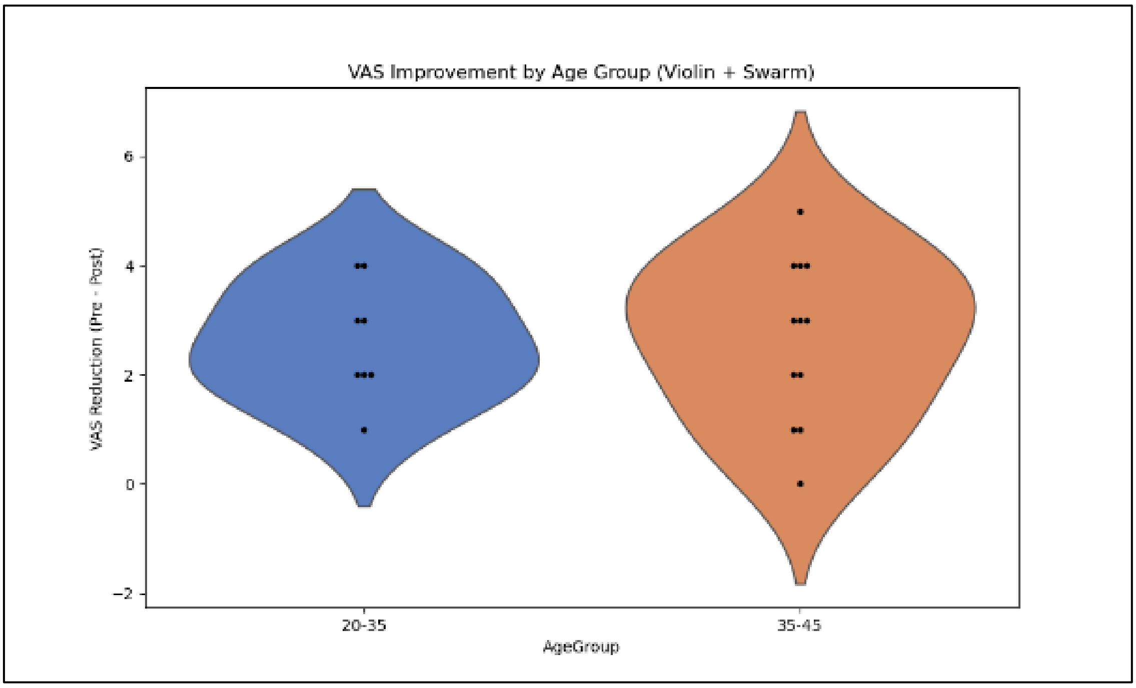

Figure 3 The distribution and variability of VAS improvements within each age group

3.4. Pain Reduction by Gender

Gender-specific analysis revealed that female participants experienced an average VAS reduction of 2.57 points, while male participants achieved a slightly higher mean reduction of 2.69 points. These findings indicate that the intervention was effective in both genders, with a marginally greater improvement observed in males. **Fig 4** shows a bar plot comparing mean VAS reductions between male and female participants. Additionally, **Fig 5** presents a ridge KDE plot illustrating the pre- and post-intervention pain distributions for each gender, highlighting the magnitude of pain reduction.

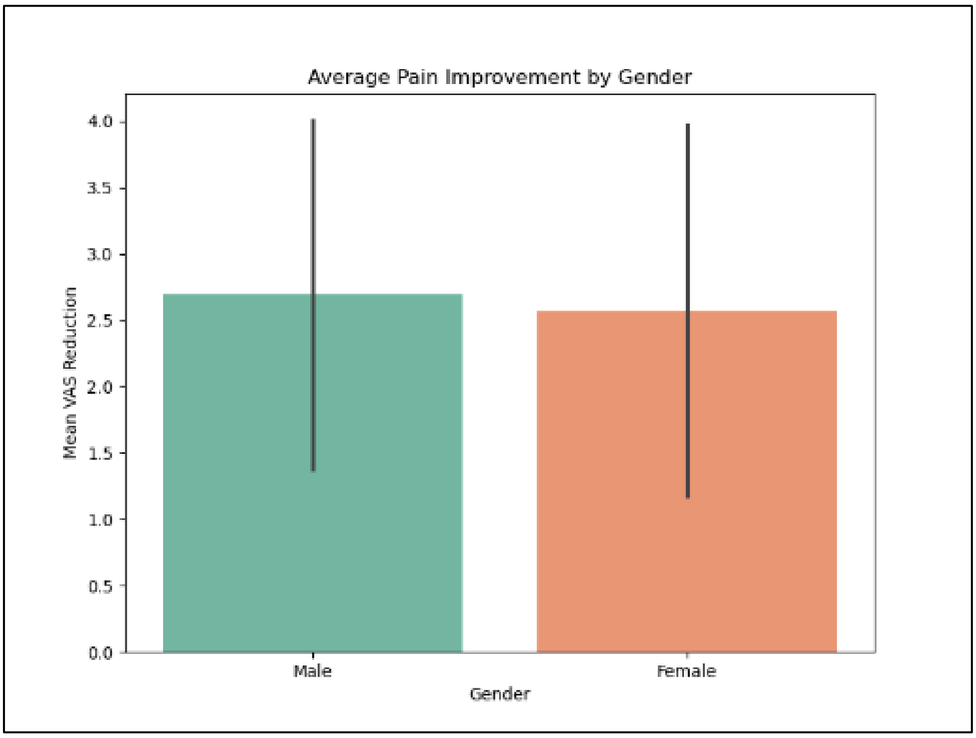

Figure 4 The comparison of mean VAS reductions between male and female participants

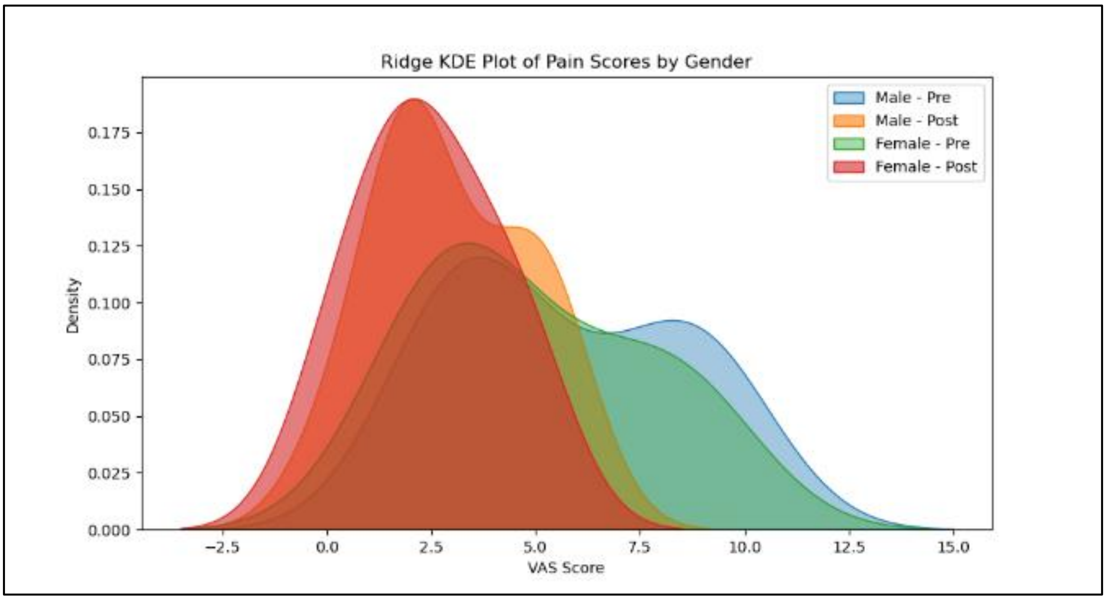

Figure 5 Ridge KDE plot illustrating the pre- and post-intervention pain distributions for each gender, highlighting the magnitude of pain reduction

4. Discussion

The study demonstrated a significant reduction in VAS pain scores, supporting previous findings that targeted interventions effectively alleviate muscle tightness and back pain. Ismaningsih et al. (2022) reported that ultrasound therapy combined with piriformis stretching significantly reduced pain in Piriformis Syndrome patients (p = 0.000), while Pavithra et al. (2024) found interferential therapy with hip muscle strengthening exercises to be more effective than ultrasound with strengthening exercises. In our study, both age groups (20–35 and 35–45 years) showed comparable improvements, consistent with literature indicating that adult age does not substantially limit intervention efficacy. Older patients may benefit more in some cases due to complex pain mechanisms and comorbidities, highlighting the importance of tailoring interventions to individual patient characteristics (Liu et al., 2007).

In our study, males showed slightly greater improvement despite females reporting higher baseline pain, consistent with prior research on sex-based differences in pain perception and treatment response (Wesselmann, 1997; Paller et al., 2009). Women generally have lower pain thresholds, higher pain sensitivity, and a greater risk of chronic pain, contributing to elevated baseline pain in Piriformis Syndrome (Berkley et al., 2002). Hormonal fluctuations and a higher prevalence of pain-related catastrophizing in women may further modulate analgesic efficacy and reduce treatment responsiveness (Paller et al., 2009). In contrast, males often exhibit lower pain sensitivity and more predictable responses to interventions, which may explain their relatively greater improvement. These findings highlight the need to consider biological, hormonal, and psychosocial factors when developing personalized pain management strategies.

We found that participants with higher initial pain still achieved substantial improvements, aligning with previous research indicating that baseline severity does not preclude therapeutic gains. Interventions such as dry needling with neurodynamic mobilization, active release therapy, and injection therapies have demonstrated significant pain reductions regardless of initial pain levels (Jaiswal et al., 2024; Ilyas et al., 2024; Hilal et al., 2022). Individual responses may vary, but high baseline pain often correlates with greater perceived improvement without uniformly predicting outcomes. Long-term interventions, such as endoscopic release, can provide lasting benefits even for patients with severe baseline pain (Vanermen and Melkebeek, 2022). These findings underscore that patients with elevated baseline pain should not be excluded from therapeutic interventions, as meaningful improvements are achievable.

The intervention demonstrated broad effectiveness, indicating its potential for general clinical application in managing pain across diverse populations. However, the study’s small sample size and uneven gender distribution should be acknowledged, and future research with larger, more balanced cohorts is warranted to validate these findings and further explore intervention outcomes.

5. Conclusion

The present study demonstrates that the intervention effectively reduces muscle tightness and back pain, yielding significant decreases in Visual Analogue Scale (VAS) scores across all participants. Both age groups (20–35 and 35–45 years) showed comparable improvements, and both males and females benefited, with slightly higher gains observed in males. Importantly, participants with higher baseline pain also experienced substantial improvements, indicating that initial pain severity does not limit the effectiveness of the intervention. These findings highlight the potential of the intervention for broad clinical application in pain management across diverse populations. However, the small sample size and gender imbalance warrant caution, and future research with larger, more balanced cohorts is recommended to confirm these results and further explore the influence of demographic and biological factors on treatment outcomes.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors report no conflicts of interest.

Authors' contributions

Conceptualization; Betcy biju, Varadharajulu Govindha Mandiri, Funding acquisition; Varadharajulu Govindha Mandiri, Data curation, Formal analysis, Project Administration, Investigation, Methodology; Betcy biju, Varadharajulu Govindha Mandiri Resources; Software; Betcy biju, Supervision; Varadharajulu Govindha Mandiri Validation; Varadharajulu Govindha Mandiri, Visualization; Betcy biju, Roles/Writing – original draft; Betcy biju, and Writing - review & editing; Varadharajulu Govindha Mandiri.

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