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Original Research

The Efficacy of Lavender Essential Oil for Anxiety and Pain Reduction during Single-Rod Contraceptive Implantation

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Abstract

Lavender essential oil aromatherapy has been explored for its potential to alleviate anxiety and pain during medical procedures. This randomized controlled trial investigated its efficacy in reducing anxiety and pain levels during single-rod contraceptive implantation. Conducted at the Gynecology Clinic, Thammasat University Hospital, Thailand, between June and December 2024, the study enrolled volunteers seeking contraceptive implant services. Participants were randomly assigned to inhale either lavender essential oil or normal saline 15 minutes before the procedure, using a cotton swab with four drops of the assigned scent held 10 cm from the nose. Anxiety levels were measured using the Visual Facial Anxiety Scale (VFAS) before, during, and 15 minutes after the procedure; while pain was assessed with the Visual Analog Scale (VAS) during local anesthesia administration and implant insertion. A total of 200 participants were evenly divided into the lavender and control groups, with no significant differences in baseline characteristics. Lavender aromatherapy demonstrated a significant reduction in both anxiety and pain severity. Before the procedure, a greater number of participants in the lavender group reported mild anxiety compared to the control group (45 vs. 26, $p < 0.001$), and severe anxiety during implantation was markedly lower (1 vs. 27, $p < 0.001$). Similarly, during local anesthesia, a significantly higher proportion of participants in the lavender group reported mild pain (50 vs. 34, $p = 0.004$); while fewer experienced severe pain (5 vs. 19). Comparable trends were observed during implantation, with fewer participants reporting moderate (12 vs. 21, $p = 0.027$) and severe pain (1 vs. 6). These findings highlight the sedative and calming effects of lavender aromatherapy, demonstrating its potential as a simple and non-invasive intervention for managing anxiety and pain during contraceptive implantation.

Keywords: Lavender; Single-rod contraceptive implantation; Pain; Anxiety

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Introduction

Aromatherapy using essential oils is an alternative approach to alleviate anxiety and pain. Inhalation of essential oil scents stimulates the olfactory system and receptors within the central nervous system and initiates psychophysiological changes that affect inhibitory neurons associated with anxiety, depression, and pain reduction. Lavender essential oil has been widely used for its pain-relieving and anti-inflammatory properties. A study by Abbasijahromi et al. [1] demonstrated that inhaling lavender oil can significantly reduce anxiety levels following cesarean section surgeries. A study by Jones et al. [2] showed that inhalation of lavender essential oil significantly reduced anxiety levels during intrauterine insemination procedures in patients with infertility. And a study by Sujitrom et al. [3] found that lavender and chamomile essential oils effectively reduced pain and anxiety associated with amniocentesis.

Because unintended pregnancies are a significant public health issue in Thailand, as they are globally, the Thai National Health Security Scheme allows Thai women under the age of 20 to receive contraceptive implant services free of charge. Contraceptive implants are suitable for women in general who seek long-term temporary pregnancy prevention, as they are highly effective, with a failure rate of only 0.1% [4].

Typically, a local anesthetic is administered before the implant procedure to minimize pain during the process; however, recipients may still experience anxiety due to the relatively painful nature of the procedure compared to other contraceptive methods, such as oral contraceptive or injectable contraceptive.

The Visual Analog Scale (VAS) is a practical and reliable method for evaluating pain [5]. The Visual Facial Anxiety Scale (VFAS) is a validated tool for assessing anxiety levels, as demonstrated in studies by Cao [6] and Yumul [7]. These studies confirm its effectiveness in measuring acute anxiety and its reliability in evaluating anxiety among postoperative patients. The VFAS is easy to administer, making it particularly suitable for use in time-sensitive operative and clinical settings.

If lavender essential oil is an effective method for alleviating pain and anxiety, its application could increase the uptake of contraceptive implant services. This study aimed to investigate the effectiveness of lavender aromatherapy in reducing anxiety and pain levels during single-rod contraceptive implantation.

Materials and Methods

Women who received single-rod contraceptive implant services between June and December 2024, at the Gynecology Clinic, Thammasat University Hospital, Thailand, were eligible to participate. For participants under 18 years, parental or legal guardian consent was required. Potential participants were excluded if they required multiple contraceptive implants, required simultaneous removal and reinsertion of implants, had olfactory impairments, psychiatric disorders, or a history of allergy to lavender essential oil, or if they declined to provide informed consent.

This study received ethical approval from the Ethics Committee of the Faculty of Medicine, Thammasat University (MTU-EC-OB- 2-291/66) and was registered in the Thai Clinical Trials Registry on May 4, 2024 (TCTR20240504003). Eligible participants were provided with comprehensive information about the study and invited to participate. Those who consented signed a consent form and had the right to refuse to participate or withdraw from the study at any point. For participants unable to read or write, a relative or an impartial individual read the consent form aloud.

Demographic data, including age, weight, height, education, occupation, parity, previous contraceptive implantation history, and previous gynecological surgery, were collected from each participant. Participants were randomly assigned to either the lavender or control group using block randomization with a block size of four by using a computer-generated random number table and kept in sealed envelope. The allocation sequence was generated by a research assistant who was not involved in participant recruitment or outcome assessment to ensure balanced group sizes throughout enrollment. Both care providers and outcome assessors were blinded to group assignments. The lavender group was assigned to inhale lavender essential oil (Pure lavender oil®, Royal Project Foundation, Thailand) prior to the implant procedure; while the control group was assigned to inhale normal saline solution. Before initiating the procedure, nurses measured participants' vital signs to evaluate their health status. Participants in the lavender group inhaled scent from cotton with 4 drops of lavender essential oil, held 10 cm from their noses, for 15 minutes prior to the procedure.

Anxiety was assessed using VFAS and pain was assessed using VAS. These psychometric tools are simple, reliable in acute care settings, and suitable for quick assessment in outpatient procedures. The tools measuring pain and anxiety consisted of a 10-cm horizontal line with a scale from 0, indicating no pain or anxiety, to 10, representing the worst possible pain or anxiety.

Participants in each group were assessed for expected anxiety using the VFAS before undergoing single-rod contraceptive implantation. The procedure began with the application of an antiseptic solution for sterilization, followed by the administration of 5 mL of 1% lidocaine as a local anesthetic. The VFAS was used

again to measure anxiety during implantation and 15 minutes post-procedure. The VAS was used to assess pain level at the time of local anesthetic administration and during implantation. Additionally, participants were monitored by the medical team for any complications related to the inhaled agents for 30 minutes prior to discharge.

The sample size was calculated based on a pilot study. The standard deviation of anxiety during implantation in the control group was 1.38. The significance levels, alpha and beta, were set at 0.05 and 0.20, respectively. Based on this, at least 82 participants per group were required to achieve statistical power. To account for a potential 20 percent dropout rate, the sample size was increased to 100 participants per group. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS Inc., Singapore), version 29 for Windows. Continuous variables were analyzed using the t-test. While categorical variables were assessed using the chi-square test when appropriate. A *p* value of less than 0.05 was considered statistically significant (Figure 1).

The primary outcome of this study was the comparison of anxiety and pain between the lavender and the control groups. The study sought to evaluate the effectiveness of lavender aromatherapy in reducing anxiety and pain associated with contraceptive implantation.

Results

A total of 200 participants were enrolled and divided into two groups. The mean age was 24.10 years, with an average BMI of 21.77 kg/m². While BMI did not significantly differ between groups, participants represented a range of body types from underweight-to-obese. Education levels were comparable, with most holding at least a secondary degree. No significant differences were observed between the groups in terms of age, BMI, parity, education, occupation, history of contraceptive implantation, or history of gynecologic surgery (Table 1). No adverse events or complications related to the inhaled agents were reported during the 30-minute observation period prior to discharge.

Lavender aromatherapy reduced pain and anxiety at all stages of the procedure. During local anesthesia, the lavender group reported a lower median pain score (3.5 vs. 4), likely due to lavender's sedative properties, which may lower pain perception thresholds. Pain during implantation was also reduced, although the median scores remained low (2 in both groups). These findings align with previous research showing lavender's ability to modulate sensory processing and promote relaxation.

Anxiety levels were consistently lower in the lavender group. Before the procedure, participants who received lavender aromatherapy reported lower median anxiety scores (4 vs. 5.5). This effect became more pronounced during the procedure (2 vs. 4), showing lavender's ability to alleviate acute stress. Post-procedural anxiety was also lower (1 vs. 2), suggesting a lasting calming effect (Table 2).

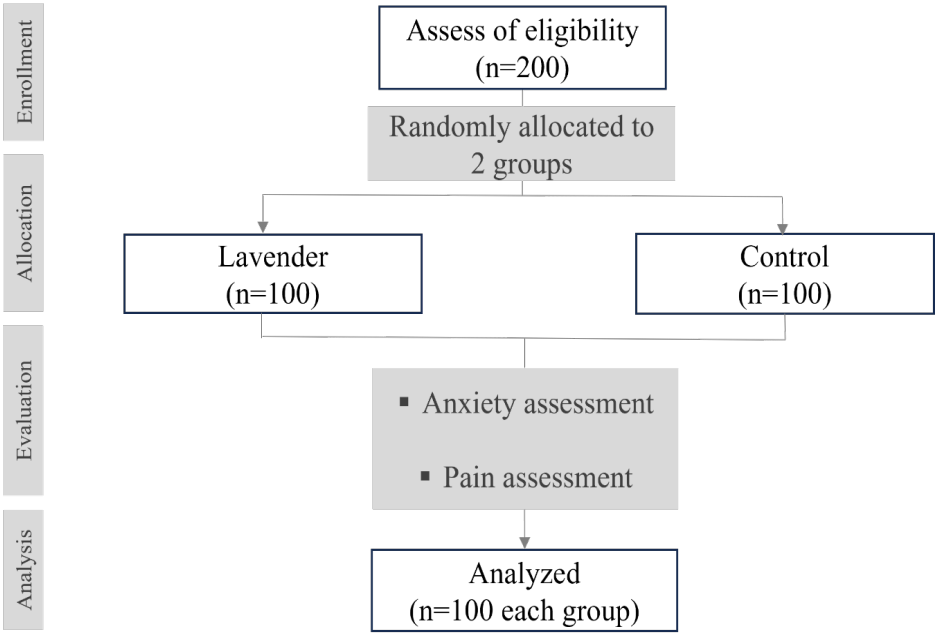

Figure 1. Flow chart study; Lavender: inhaled lavender essential oil 15 minutes prior to the contraceptive implantation; Control: inhaled normal saline 15 minutes prior to the contraceptive implantation; Anxiety assessment: evaluation of anxiety before, during and 15 minutes after procedure; Pain assessment: evaluation of pain during local anesthesia and during implantation.

Table 1. Comparison of baseline characteristics between the control (n=100) and lavender (n=100) groups.

	Control*	Lavender*	*p* value
Mean age ± SD (years)	23.3 ± 6.4	24.9 ± 7.7	0.089
Mean BMI ± SD (kg/m^2)	21.4 ±4.5	22.2 ± 4.4	0.204
BMI category			0.439
Underweight	23 (23)	21 (21)	
Normal	63 (63)	56 (56)	
Overweight	10 (10)	16 (16)	
Obese	4 (4)	7 (7)	
Nulliparity	74 (74)	71 (71)	0.751
Education level			0.417
≤ Secondary	63(63)	57 (57)	
≥ Bachelor	37 (37)	43 (43)	
Occupation			0.154
Housewife	7 (7)	10 (10)	
Student	65 (65)	49 (49)	
Employee	20 (20)	30 (30)	
Self-employed	8 (8)	11 (11)	
History of contraception	20 (20)	29 (29)	0.139
History of gynecologic surgery	3 (3)	5 (5)	0.470

BMI: body mass index; SD: standard deviation; *n (%); Lavender: inhaled lavender essential oil 15 minutes prior to the contraceptive implantation; Control: inhaled normal saline 15 minutes prior to the contraceptive implantation.

Table 2. Comparison of pain and anxiety scores (VAS and VFAS) during single-rod contraception implantation between the control (n=100) and lavender (n=100) groups.

	Control* Median (IQR)	Lavender* Median (IQR)	*p* value
Pain score (VAS)			
Local anesthesia	4 (2.25, 6)	3.5 (3, 5)	0.017
Implantation	2 (1, 4)	2 (1, 3)	< 0.001
Anxiety score (VFAS)			
Before	5.5 (3, 7)	4 (2, 6)	< 0.001
During	4 (3, 7)	2 (1, 3)	< 0.001
After	2 (1, 3)	1 (1, 2)	< 0.001

*Median (Interquartile range; IQR); Lavender: inhaled lavender essential oil 15 minutes prior to the contraceptive implantation; Control: inhaled normal saline 15 minutes prior to the contraceptive implantation; VAS: Visual Analog Scale (range 0-10); VFAS: Visual Facial Anxiety Scale (range 0-10).

The comparative distribution of pain severity further highlights the benefits of lavender aromatherapy. During local anesthesia, mild pain (VAS 1–3) was reported by 50 participants in the lavender group compared to 34 in the control group ($p = 0.004$). Moderate pain (VAS 4–6) was reported by 45 participants in the lavender group and 47 in the control group. Severe pain (VAS 7–10) was significantly lower in the lavender group (5 vs. 19). During the implantation, 87 participants in the lavender group experienced mild pain compared to 73 participants in the control group ($p = 0.027$). The number of participants reporting moderate pain was lower in the lavender group (12 vs. 21), and severe pain was infrequent (1 vs. 6). These differences highlight lavender's effectiveness in reducing discomfort (Figure 2).

Anxiety severity also differed significantly between groups. Before the procedure, 45 participants in the lavender group reported mild anxiety (VFAS 1–3) compared to 26 participants in the control group ($p < 0.001$). During the procedure, the difference became even more pronounced, with 77 participants in the lavender group experiencing mild anxiety compared to 32 participants in the control group. Severe anxiety (VFAS 7-10) during the procedure was almost eliminated in the lavender group (1 vs. 27). After the procedure, 99 participants in the lavender group reported mild anxiety, compared to 79 participants in the control group, highlighting the enduring calming effect of lavender aromatherapy (Figure 3).

Discussion

This study found that lavender aromatherapy effectively reduced anxiety and pain during single-rod contraceptive implantation. More participants in the lavender group reported mild pain during local anesthesia and implantation; while severe pain was notably lower. Anxiety levels also improved, with more

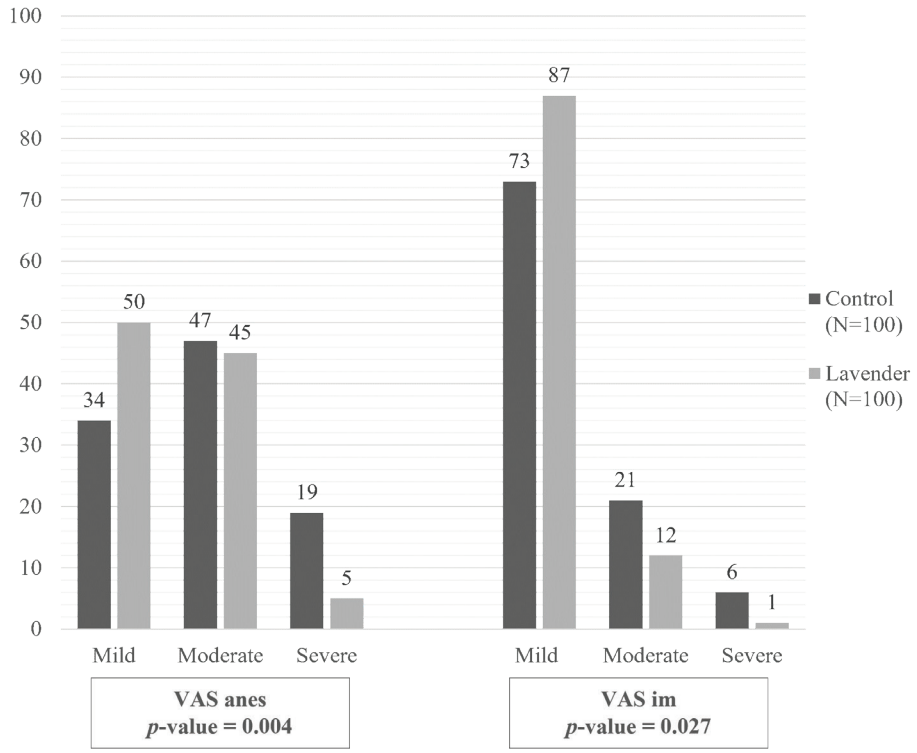

Figure 2. Comparisons of categorized pain scores (VAS) during single-rod contraceptive implantation between the control and lavender groups; Control: inhaled normal saline 15 minutes prior to the contraceptive implantation; Lavender: inhaled lavender essential oil 15 minutes prior to the contraceptive implantation; VAS anes: Visual Analog Scale during local anesthesia; VAS im: Visual Analog Scale during implantation.

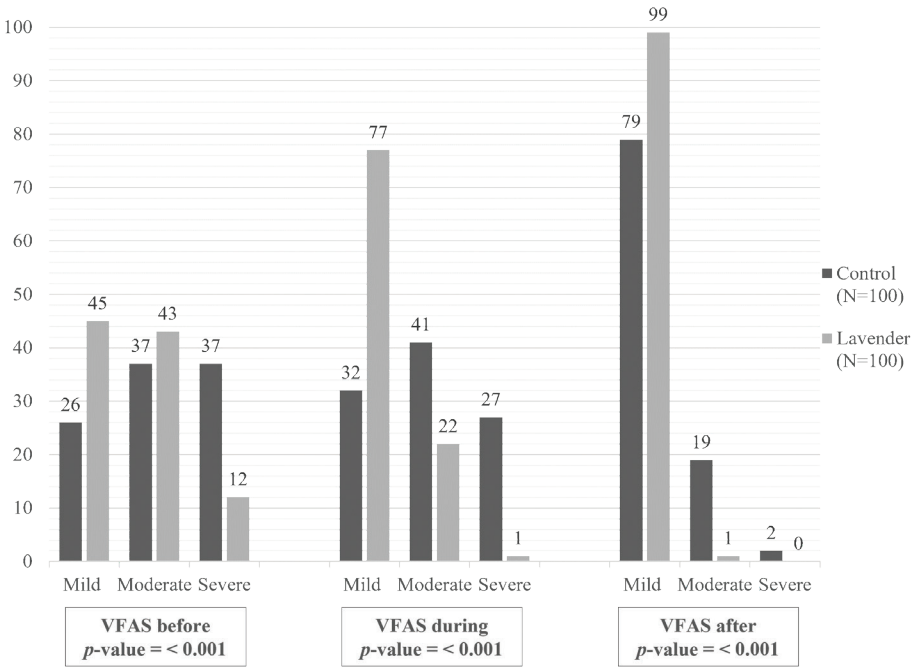

Figure 3. Comparisons of categorized anxiety scores (VFAS) during single-rod contraceptive implantation between the control and lavender groups; Control: inhaled normal saline 15 minutes prior to the contraceptive implantation; Lavender: inhaled lavender essential oil 15 minutes prior to the contraceptive implantation; VFAS before: Visual Facial Anxiety Scale before implantation; VFAS during: Visual Facial Anxiety Scale during implantation, VFAS after: Visual Facial Anxiety Scale after implantation.

participants in the lavender group experiencing mild anxiety before, during, and after the procedure; while severe anxiety was nearly eliminated. These findings highlight lavender's effectiveness in minimizing discomfort and anxiety.

These findings align with previous research indicating that lavender reduces anxiety by modulating the limbic system and enhancing parasympathetic activity [8-9]. Active components of lavender oil are linalool and linalyl acetate. These substances may inhibit voltage-gated calcium channels and reduction of $5HT1_A$ receptor activity in the hippocampus and anterior cingulate cortex. These brain regions implicated in anxiety regulation suggestion central mechanism similar to that of selective serotonin reuptake inhibitors (SSRIs) and electroconvulsive therapy. Additionally, lavender essential oil increases parasympathetic tone and reduces autonomic arousal, which may contribute to anxiety reduction during procedures [10-11].

Beyond its psychological benefits, lavender's mild analgesic effects may help ease procedural discomfort, as supported by studies on its role in postoperative pain management [12]. Its heightened effectiveness during procedures, rather than before or after, underscores its ability to manage acute stress. This is consistent with findings from the study by Rajai et al. [13] and a systematic review by Ghavami et al. [14], both of which shown peak efficacy during periods of intense emotional arousal. Previous studies have demonstrated the effectiveness of lavender aromatherapy in reducing pain and anxiety across various medical procedures. Çalışır et al. [15] reported that lavender aromatherapy effectively reduced intraoperative anxiety during cesarean sections. Similarly, Hadi et al. [16] found that lavender essence significantly decreased post-cesarean section pain, as measured by the VAS. In 2016, Karaman et al. [17] evaluated the effects of lavender oil inhalation administered 5 minutes before the procedure, comparing it with a placebo using the VAS and Spielberger State-Trait Anxiety Inventory. The inhaled lavender essential oil significantly reduced pain and anxiety during venipuncture procedures. Additionally, its dual-action mechanism—addressing both sensory and psychological aspects of pain and anxiety—reinforces its value as an adjunctive therapy [18]. A summary comparing the current study with previous studies was presented in table 3.

This study provides valuable insights into safe, effective ways to reduce pain and anxiety during contraceptive implantation, with potential clinical applications. Its strength lies in its design as a prospective randomized controlled trial, and the participants had similar demographic characteristics.

From a public health perspective, integrating lavender aromatherapy into standard medical practices could improve patient-centered care. Procedural anxiety and

Table 3. Comparison of the current and previous studies on lavender aromatherapy for pain and anxiety reduction.

	Present	Çalışır	Hadi	Karaman	Rajai	Ghavami
Year	2025	2023	2011	2016	2016	2022
Country	Thailand	Türkiye	Iran	Türkiye	Iran	Iran
Procedure	Implant	C/S, SB	C/S, NA	VP	CABG	SR
Route	In	In	In	In	In	In/Top
Duration	15 min/B	NA	NA	5 min/B	B/A	Various
Assessment						
VFAS	Y					
VAS	Y	Y	Y	Y		
STAI		Y		Y		
DASS					Y	Y
PSS						Y
Finding						
Decrease anxiety	Y	Y		Y	Y	Y
Decrease pain	Y		Y	Y		
Decrease stress					Y	Y

C/S: Cesarean section; SB: Spinal anesthesia, NA: not available; VP: Venipuncture; CABG: Coronary artery bypass grafting; SR: systematic review; In: Inhale; Top: topical; B: Before procedure; A: After procedure; Y: Yes; VFAS: Visual Facial Anxiety Scale; VAS: Visual Analog Scale; STAI: State Trait Anxiety Inventory; DASS: The Depression Anxiety Stress Scales; PSS: Perceived Stress Scale

pain often deter healthcare access, especially among marginalized populations with limited health literacy or heightened medical fears [19]. For example, while contraceptive implants are highly effective for long-term pregnancy prevention, their relatively painful insertion can cause significant anxiety compared to less invasive methods like oral contraceptives or injectables. Given its affordability and non-invasive nature, lavender aromatherapy presents a practical option for low-resource settings, potentially reducing disparities in patient experiences and improving adherence to medical treatments. Moreover, its ability to ease both physical and psychological symptoms align with holistic healthcare models focused on overall well-being [20].

Behavioral theories like the Health Belief Model (HBM) can help promote lavender aromatherapy in clinical settings by highlighting its benefits in reducing anxiety and pain, thereby improving patient acceptance. Addressing concerns about its efficacy and safety through patient education campaigns may further support its adoption [21]. Similarly, Social Cognitive Theory (SCT) suggests that modeling and vicarious learning can encourage uptake. Training healthcare providers to administer lavender aromatherapy and sharing positive patient testimonials could foster greater acceptance among both patients and practitioners [22].

Several limitations should be noted. This single-center study used a single-blinded design, meaning participants knew which substance—lavender or saline—they inhaled. Additionally, reliance on self-reported measures—VFAS and VAS—introduced potential bias influenced by individual perceptions of anxiety and pain. Future research could examine the effectiveness of other essential oils across different medical procedures, offering a broader perspective on their role in pain and anxiety management.

Conclusion

Lavender aromatherapy effectively reduces anxiety throughout contraceptive implantation and alleviates pain during both local anesthesia administration and implantation. Its affordability, non-invasive nature, and proven efficacy make it a promising option for managing anxiety and pain. Additionally, its potential for widespread use could help reduce disparities in patient experiences and serve as a viable method for anxiety and pain relief in other medical procedures, ultimately improving compliance with medical interventions.

Conflict of Interests

The authors declares that there is no conflict of interest.

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