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Effect of Moderate Intensity Walking and Transcutaneous Electrical Nerve Stimulation with Stretching on Restless Leg Syndrome Severity and Sleep Quality in Pregnant Women- A Comparative Study

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ABSTRACT:

Objective: The study objective to compare the effectiveness of moderate-intensity walking with stretching and Transcutaneous Electrical Nerve Stimulation (TENS) with stretching on RLS severity and sleep quality among pregnant women.

Methods: A randomized controlled trial was used with pre-test and post-test assessment. 60 women diagnosed with RLS were selected and randomized into two groups. Group A was given TENS along with stretching while Group B did moderate-intensity walking with stretching. Both interventions were applied for thirty minutes, five times per week for four weeks. The International Restless Legs Syndrome Rating Scale (IRLSRS) and Pittsburgh Sleep Quality Index (PSQI) were the outcome measures. Statistical analysis was conducted with paired t-tests, independent t-tests, and repeated measures ANOVA at a significance level $p < .05$.

Results: The findings demonstrated statistically significant improvements in both IRLSRS and PSQI scores within both groups ($p < .001$). However, the walking with stretching group showed comparatively greater improvement in sleep quality and reduction in RLS severity compared to the TENS with stretching group. Large effect sizes further confirmed the clinical effectiveness of both interventions.

Conclusions: Both interventions were effective non-pharmacological treatment options for RLS during gestation. According to the findings, moderate walking along with stretching could improve sleep quality and reduce symptoms of RLS in pregnant women.

INTRODUCTION

Restless Legs Syndrome (RLS) is a common neurological and sleep disorder seen often in pregnancy. It tends to occur in the second and third trimesters. This condition is characterized by an irresistible urge to move the legs that can be unpleasant. Symptoms are worse at rest and overnight, which leads to sleep disturbance and reduced quality of life. Research suggests that RLS (restless legs syndrome) during pregnancy may occur in 10-34% of women, with severity increasing as the pregnancy advances (Srivanitchapoom et al., 2014). According to Sarberg et al. (2012), RLS prevalence escalated from 17% in the first trimester to 29.6% in the third trimester, indicating progressive worsening during pregnancy. Moreover, Dunietz and colleagues showed that compared with healthy pregnant women, pregnant women with RLS had significantly greater odds for poor sleep quality, daytime dysfunction, and excessive daytime sleepiness. Pharmacological management during pregnancy has risks. Due to this, there has been increasing emphasis on non-pharmacological means for symptom control and improving sleep. As stated by Grover et al. (2015), physiotherapy-based safe approaches can be used for the management of RLS in pregnant women. Whereas, Jahani Kondori et al. (2020) mentioned that non-pharmacological therapies are safer during pregnancy and lactation. Birsner and Gyamfi-Bannerman (2015) also concluded that being active during pregnancy is safe and healthy for the mother. The researchers Liu et al. (2025) presented the findings of their study, in which they performed a meta-analysis on pregnant women to understand the impact of physical activity on sleep disorders. As a result, moderate-intensity walking, stretching exercises, along with Transcutaneous Electrical Nerve Stimulation (TENS) can provide effective and safe management strategies to reduce the severity of restless leg syndrome (RLS) and improve sleep quality in pregnant women. The literature on Restless Legs Syndrome (RLS) in pregnancy has increased, but important research gaps remain. Research on RLS has mostly been done on its prevalence, pathophysiology, and clinical characteristics rather than its physiotherapy. Though Sarberg et al. (2012), Dunietz et al. (2017), and Goecke et al. (2020) find strong evidence for a link between RLS and poor sleep in pregnancy, there are few studies that experimentally test non-pharmacological effective approaches with a pregnancy population. Moreover, it has been suggested by Grover et al. (2015) and Jahani Kondori et al. (2020) that physiotherapy-based, nonpharmacological approaches are safer than medications due to risks during pregnancy. Nevertheless, there is still no comparative evidence to determine which of these interventions leads to better improvement in RLS and sleep quality. Even though physical activity, walking, TENS, and stretching exercises have been studied on their own, there have been a rather limited number of randomized controlled trials that directly compare moderate intensity walking plus stretching with TENS plus stretching in pregnant women with RLS. Moreover, previous studies (Sokunbi et al., 2020; Lee et al., 2022) have been inconsistent on the effectiveness of TENS on sleep, suggesting a need for further clinical trial investigation. Evidence focusing on RLS severity, sleep disturbance, and daytime sleepiness using validated measures is impending. For instance, the International Restless Legs Syndrome Rating Scale (IRLSRS) and Pittsburgh Sleep Quality Index (PSQI) are validated measures. Most existing studies also did not have adequate concentration on maternal comfort, functional status, and long-term physiotherapy outcomes during pregnancy. As a result, the present study was designed to fill these gaps by comparing moderate-intensity walking with stretching and TENS with stretching on RLS severity and sleep quality in pregnant women through a randomized controlled trial design.

METHODS

Study Design and Participants

This randomised controlled trial (RCT) with a pre-test–post-test design was conducted at the Department of Physiotherapy, Jagannath University, Jaipur, and affiliated Physiotherapy clinics. A total of 72 pregnant women were screened for eligibility, of whom 60 met the inclusion criteria and were enrolled. Participants were aged 20–35 years, had a gestational age of 20–32 weeks, and were clinically diagnosed with Restless Legs Syndrome (RLS). Women with high-risk pregnancies, significant neurological, musculoskeletal, cardiovascular, or psychiatric disorders, contraindications to TENS, or participation in other structured exercise programmes were excluded. Written informed consent was obtained from all participants.

Randomisation and Blinding

Participants were randomly allocated in a 1:1 ratio to either the TENS with stretching group ($n = 30$) or the moderate-intensity walking with stretching group ($n = 30$) using a computer-generated randomisation sequence. Allocation concealment was ensured through sequentially numbered, opaque, sealed envelopes prepared by an independent researcher. Due to the nature of the interventions, participant and therapist blinding was not feasible; however, outcome assessment and statistical analysis were performed by a blinded investigator.

Intervention

Group A received TENS combined with stretching exercises, while Group B performed moderate-intensity walking combined with stretching exercises. Both interventions were administered for 30 minutes per session, five days per week, for four weeks. Attendance was monitored throughout the study, and all participants completed the intervention protocol without dropouts. Figure 1 illustrates the intervention procedures administered during the study. These interventions were administered to evaluate their effects on RLS severity and sleep quality among pregnant women.



Statistical Analysis

RLS severity and sleep quality were assessed before and after the intervention using the International Restless Legs Syndrome Rating Scale (IRLSRS) and the Pittsburgh Sleep Quality Index (PSQI), respectively. Data were analysed using SPSS version 27. Paired t-tests, independent t-tests, and repeated-measures ANOVA were applied, with statistical significance set at $p < 0.05$.

The study was conducted and reported in accordance with the CONSORT 2022 guidelines for randomised controlled trials. CONSORT flow diagram showing participant screening (n = 72), exclusions (n = 12), enrolment (n = 60), random allocation to TENS with Stretching (n = 30) and Walking with Stretching (n = 30), intervention completion, and inclusion in the final analysis. No participants were lost to follow-up or excluded after randomisation.

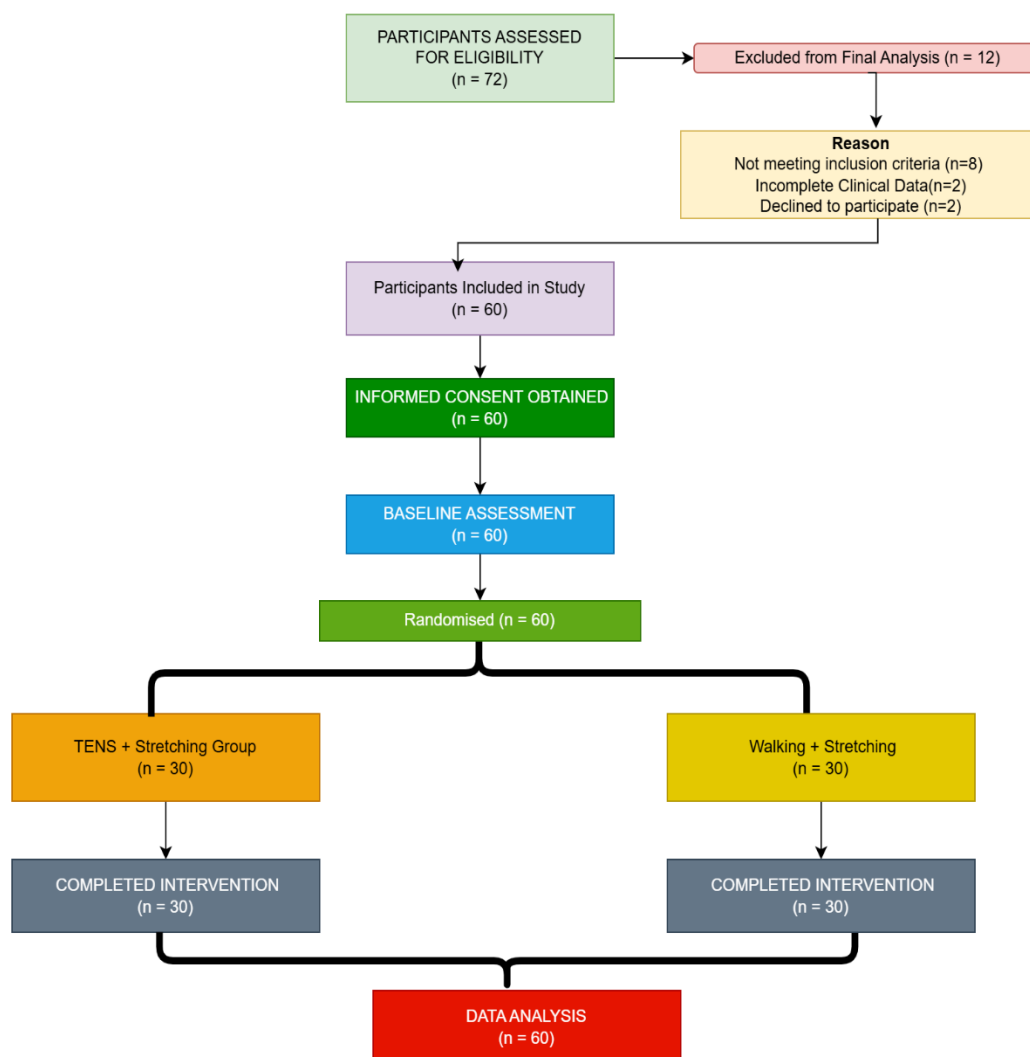


Figure 2. CONSORT 2022 Participant Flow Diagram for the Randomised Controlled Trial Comparing TENS with Stretching and Moderate-Intensity Walking with Stretching in Pregnant Women with Restless Legs Syndrome (RLS)

RESULTS

Table 1 Descriptive Statistics and Within-Group Changes in IRLS and PSQI Scores (N = 60)

Outcome	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Diff	95% CI of Mean Difference	t(59)	p	Cohen's d
IRLS	25.98 ± 2.55	16.38 ± 2.89	9.60	9.23- 9.97	52.49	< .001	6.78
PSQI	11.37 ± 1.07	6.73 ± 1.51	4.63	4.34-4.93	31.649	< .001	4.08

p < 0.05*

Table 2 Post-Intervention Comparison Between TENS + Stretching and Walking + Stretching Groups (N = 60)

Outcome	TENS + Stretching Mean $\pm$ SD (n = 30)	Walking + Stretching Mean $\pm$ SD (n = 30)	Mean Diff	95% CI of Mean Difference	t(58)	p	Cohen's d
IRLS Post	17.00 $\pm$ 2.78	15.77 $\pm$ 2.91	1.23	-0.24-2.70	1.68	.099	0.43
PSQI Post	7.47 $\pm$ 1.31	6.00 $\pm$ 1.34	1.47	0.78-2.15	4.30	< .001	1.11

p < 0.05*

Table 3 Comparison of Change Scores Between Groups

Outcome	TENS + Stretching Mean $\pm$ SD	Walking + Stretching Mean $\pm$ SD	Mean Diff	95% CI	t(58)	p	Cohen's d
IRLS Change	8.67 $\pm$ 1.15	10.53 $\pm$ 0.97	-1.87	-2.42- -1.31	-6.77	< .001	1.75
PSQI Change	3.93 $\pm$ 0.83	5.33 $\pm$ 0.96	-1.40	-1.86- -0.94	-6.05	< .001	1.56

p < 0.05*

Table 4: Repeated-Measures ANOVA Results for IRLS and PSQI Scores

Outcome	Effect	F(1,58)	p	Partial η^2
IRLS	Time	4849.55	< .001	.988
IRLS	Time $\times$ Group	45.84	< .001	.441
IRLS	Group	0.19	.663	.003
PSQI	Time	1605.47	< .001	.965
PSQI	Time $\times$ Group	36.65	< .001	.387
PSQI	Group	7.00	.010	.108

p < 0.05*

Table 5: Pearson Correlations Among IRLS and PSQI Scores

Variables	r	95% CI	p
IRLS Pre – IRLS Post	.872	.79 - .92	< .001
PSQI Pre – PSQI Post	.660	.49 - .78	< .001
IRLS Change – PSQI Change	.308	.06 - .52	.017

p < 0.05*

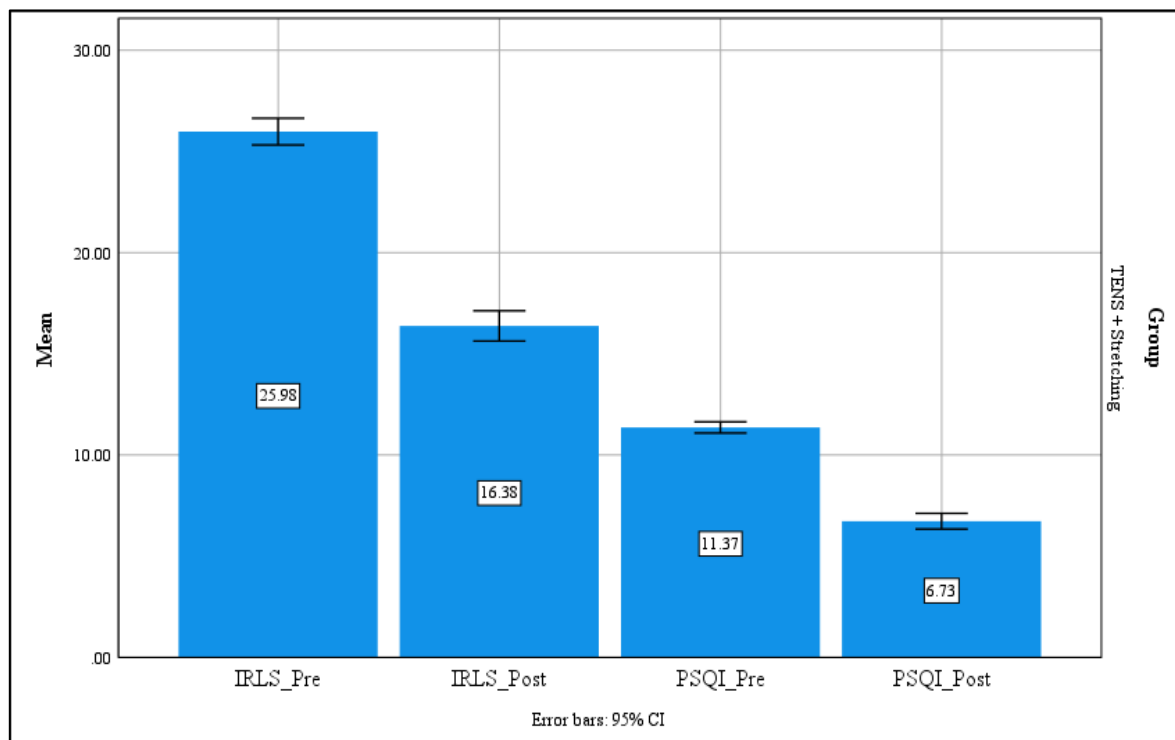


Figure 3: Mean Pre–Post Scores of IRLS and PSQI with 95% Confidence Intervals

DISCUSSION

The present randomised controlled trial was conducted to compare the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) with stretching and moderate-intensity walking with stretching on Restless Legs Syndrome (RLS) severity and sleep quality among pregnant women. The findings demonstrated that both interventions produced statistically significant improvements in RLS symptoms and sleep quality over the four-week intervention period. However, moderate-intensity walking combined with stretching showed comparatively greater benefits, particularly in improving sleep quality and reducing symptom severity.

The first objective of the study was to determine the effects of TENS with stretching and moderate-intensity walking with stretching on RLS severity and sleep quality among pregnant women. The within-group analysis revealed significant reductions in International Restless Legs Syndrome Rating Scale (IRLSRS) scores and Pittsburgh Sleep Quality Index (PSQI) scores following intervention. IRLS scores decreased from 25.98 ± 2.55 to 16.38 ± 2.89 , while PSQI scores improved from 11.37 ± 1.07 to 6.73 ± 1.51 . The observed improvements were statistically significant and accompanied by very large effect sizes, indicating substantial clinical benefits. These findings suggest that both physiotherapy-based interventions effectively reduced symptom burden and improved sleep quality among pregnant women experiencing RLS.

The observed improvements support previous literature highlighting the importance of non-pharmacological management during pregnancy. Grover et al. (2015) emphasised that pharmacological treatment options for RLS during pregnancy are limited because of concerns regarding maternal and foetal safety. Similarly, Jahani Kondori et al. (2020) reported that non-pharmacological therapies represent the safest first-line management approach for pregnant women with RLS. The significant reductions observed in both IRLS and PSQI scores in the present study provide additional evidence supporting the effectiveness of conservative physiotherapy interventions in this population.

The improvements in sleep quality observed in the present study are particularly important because sleep disturbance is one of the most disabling consequences of RLS during pregnancy. Dunietz et al. (2017) reported that pregnant women with RLS are more than twice as likely to experience poor sleep quality, impaired daytime functioning, and excessive daytime sleepiness compared with women without RLS. Likewise, Sarberg et al. (2012) demonstrated that sleep disturbances progressively worsen as pregnancy advances and that RLS prevalence increases substantially during the second and third trimesters. The present

findings indicate that reducing RLS symptom severity through physiotherapy interventions can simultaneously improve sleep quality, supporting the close relationship between symptom burden and sleep disturbance reported in previous studies.

The second objective of the study was to compare the effectiveness of the two intervention approaches. Although both interventions were beneficial, moderate-intensity walking combined with stretching demonstrated superior outcomes compared with TENS combined with stretching. Between-group analysis revealed significantly better post-intervention PSQI scores in the walking group. Furthermore, analysis of change scores showed significantly greater improvements in both IRLS and PSQI outcomes among participants receiving walking with stretching. Repeated-measures ANOVA also demonstrated significant Time $\times$ Group interaction effects for both outcome measures, indicating that the pattern of improvement differed between interventions and favoured the walking programme.

Several physiological mechanisms may explain the superior effectiveness of moderate-intensity walking. Physical activity has been shown to improve peripheral circulation, enhance neuromuscular function, reduce muscle discomfort, and promote the release of endorphins, all of which may contribute to symptom reduction. Regular walking may also improve sleep through regulation of circadian rhythms, reduction of psychological stress, and enhancement of overall physical well-being. These mechanisms are particularly relevant during pregnancy, when hormonal changes, altered circulation, and physical discomfort contribute to both RLS symptoms and sleep disturbances.

The present findings are consistent with those reported by Birsner and Gyamfi-Bannerman (2015), who concluded that physical activity during pregnancy is safe and beneficial for maternal health. Their review highlighted numerous positive outcomes associated with prenatal exercise, including improved physical functioning and overall well-being. Similarly, Marshall et al. (2021) demonstrated that moderate-intensity walking is a safe and achievable form of exercise during pregnancy and can be performed within recommended physiological limits. The current findings further extend this evidence by demonstrating that walking may also serve as an effective therapeutic intervention for pregnant women experiencing RLS.

The superior sleep outcomes observed in the walking group are also supported by the findings of Liu et al. (2025), whose meta-analysis of randomised controlled trials concluded that physical activity interventions significantly reduce sleep disturbances among pregnant women. The authors reported that structured exercise programmes improve sleep quality through multiple physiological and psychological pathways. The present study supports these conclusions, demonstrating that moderate-intensity walking combined with stretching produces meaningful improvements in sleep quality among pregnant women with RLS.

The findings regarding TENS require careful interpretation. Although TENS combined with stretching significantly improved both RLS severity and sleep quality, its effects were less pronounced than those observed with walking. TENS is believed to reduce discomfort through stimulation of peripheral nerves and modulation of pain pathways according to the gate-control theory. These mechanisms may explain the significant improvements observed within the TENS group. However, TENS primarily targets symptom relief and may not produce the broader systemic benefits associated with physical activity.

The present findings partially agree with those of Sokunbi et al. (2020), who reported that acupuncture-like TENS was not significantly superior to usual care in improving sleep quality among pregnant women. In contrast, the current study demonstrated significant within-group improvements following TENS intervention. The discrepancy may be attributable to differences in treatment protocols, intervention duration, participant characteristics, and the addition of stretching exercises in the present study. Nevertheless, both studies suggest that TENS may be less effective than active physical interventions in producing substantial improvements in sleep quality.

The significant positive correlation observed between changes in IRLS scores and changes in PSQI scores further supports the relationship between symptom reduction and sleep improvement. Participants who experienced greater reductions in RLS severity also demonstrated greater improvements in sleep quality. This finding is consistent with observations by Dunietz et al. (2017), who identified a strong association between RLS symptoms and sleep disturbances during pregnancy. The correlation suggests that successful management of RLS symptoms may directly contribute to improved sleep outcomes.

The findings of the present study are also clinically important because they provide evidence supporting accessible, low-cost, and safe treatment options for pregnant women. Current literature emphasises that pharmacological management of RLS during pregnancy remains challenging because of safety concerns. Srivannithapoom et al. (2014), Grover et al. (2015), and Jahani Kondori et al. (2020) all highlighted the need for safe alternatives during pregnancy. The present results indicate that both

walking with stretching and TENS with stretching can serve as effective non-pharmacological treatment strategies, with walking demonstrating greater overall effectiveness.

Overall, the present study achieved its objectives by demonstrating that both interventions significantly reduced RLS severity and improved sleep quality among pregnant women. However, moderate-intensity walking combined with stretching produced superior improvements compared with TENS combined with stretching. These findings contribute to the growing body of evidence supporting physiotherapy-based interventions for pregnancy-related RLS and reinforce the importance of incorporating structured physical activity into antenatal care programmes.

LIMITATIONS

The present study has certain limitations that should be considered while interpreting the findings. First, the sample size was relatively small, which may limit the generalisability of the results to the broader population of pregnant women with Restless Legs Syndrome (RLS). Second, the study was conducted at a single centre, which may reduce the external validity of the findings. Third, the intervention period was limited to four weeks; therefore, the long-term effectiveness of moderate-intensity walking with stretching and TENS with stretching could not be evaluated. Fourth, no long-term follow-up assessment was performed after completion of the intervention programme, making it difficult to determine whether the observed improvements in RLS severity and sleep quality were sustained over time. Future multicentre studies with larger sample sizes, longer intervention durations, and follow-up assessments are recommended to further establish the effectiveness and sustainability of these non-pharmacological interventions in pregnant women with RLS.

CONCLUSION

As per the current research, it was found that TENS with stretching as well as moderate-intensity walking with stretching helped in the non-pharmacological management of restlessness legs syndrome among pregnant women. This helped in the reduction of the severity of RLS disorder and improved sleep quality. After four weeks of intervention, there was a significant improvement in IRLSRS and PSQI scores. Physiotherapy-based management can be a useful tool in controlling RLS symptoms during pregnancy. The findings further showed that moderate-intensity walking plus stretching was more effective than TENS with stretching for sleep quality and symptom reduction. However, both analyses using repeated measures and very large effect sizes confirmed that both treatment approaches were clinically effective. The findings add to the growing body of evidence that safe physical activity and structured physiotherapy/other interventions have the potential to significantly enhance maternal comfort, sleep quality and well-being during pregnancy. Due to the potential risks associated with medicinal treatment of RLS in pregnancy to the mother and the child, various safe, accessible, and cost-effective options for clinical practice could include non-medicinal therapies like walking, stretching, and TENS. Consequently, the study recommends the inclusion of moderate-intensity walking and stretching exercises in routine antenatal physiotherapy programmes for pregnant women with RLS symptoms. Long multicentre studies with a larger sample size would be recommended to ensure the generalisability of findings.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study.

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DATA AVAILABILITY STATEMENT

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee of Jagannath University, Jaipur. Written informed consent was obtained from all participants prior to enrolment in the study. CTIRI hasn't done.

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