# Effect of Vibration, Electrical Stimulation and Other Non-Pharmacological Interventions on Restless Leg Syndrome Severity and Sleep Quality: A Systematic Review and Meta-Analysis

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## Abstract

**Background and Objectives:** This study aims to determine the effect of nonpharmacological treatments, such as vibration, electric stimulation, acupressure, massage therapy, cryotherapy, and exercise, on the restless legs syndrome (RLS) severity score. **Methods:** Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines were followed for selecting studies to be included in the meta-analysis. The International Prospective Register of Systematic Reviews (PROSPERO) registered this study. Many databases, including Google Scholar, Embase, PubMed, and Scopus, were utilized to locate randomized controlled trials (RCTs). The analysis employed Cochrane's risk of bias tool 2.0 to evaluate the quality of the incorporated RCTs. Standardized mean difference (SMD) figures were employed for all outcomes to assess the impact of every nonpharmacological intervention. The aggregate effect of each was expressed using forest plots. A random-effects model was used for pooling. The heterogeneity of the included studies was evaluated using I2 values. All relevant statistical calculations were carried out using R Studi version 4.3.0. **Results:** A total of 17 studies were selected for meta-analysis. There was a significant reduction in RLS severity after vibration/stimulation (SMD −1.09, 95% CI −2.45 to −0.27, $P = 0.014$), and a non-significant trend for acupressure (SMD −0.87, 95% CI −2.21 to 0.47, $P = 0.203$), massage therapy (SMD −3.49, 95% CI −10.81 to 3.83, $P = 0.350$), cryotherapy (SMD −1.27, 95% CI −3.72 to 1.18, $P = 0.309$), and exercise (SMD −2.05, 95% CI −23.95 to 19.84, $P = 0.856$). There was an improvement in sleep quality measured using the pooled Pittsburgh Sleep Quality Index after the nonpharmacological intervention (SMD: -0.51, 95% CI: -0.73 to -0.28). However, this improvement was not found to be significant ($P = 0.73$). **Conclusions:** The study demonstrated significant reductions in RLS severity with nonpharmacological interventions, offering viable alternatives to medication. However, the improvement in sleep quality was not statistically significant. Further research is needed to optimize these treatments.

**Keywords:** RLS, vibration, electrical current, stimulation, cryotherapy, acupressure, exercise, massage, sleep quality

## Introduction

The neurological and sleep problem known as restless legs syndrome (RLS) is typified by painful leg sensations and an overwhelming need to move the legs.[1] RLS symptoms usually manifest in the evening and at night, when one is resting or not moving, and they cause disruptions in sleep.[2] RLS is linked to a higher risk of suicide, self-harming behaviors, and medical conditions, as well as daytime sleepiness, lower quality of life, poor memory, cognitive functioning, and decreased work performance.[3–6]

Despite the possibility of RLS being primary (genetically connected), it is also linked to several illnesses, such as peripheral neuropathy, kidney disease, iron insufficiency, and neurodegenerative diseases like Parkinson's disease (PD).[7]

Levodopa was the first medication to be employed for treating RLS in 1982,[8] although, despite its effectiveness, augmentation occurs at all dosages.[8-10] Between 2004 and 2009, dopamine agonists such as pramipexole, ropinirole, and rotigotine received approval for the treatment of RLS,[11,12] and they are currently utilized in the first-line scenario.[13] However, dopaminergic medications still cause amplification to varying degrees. Neurologists have tried to find alternatives, like α2δ ligands[14] and opioids,[15] or optimize drug use to address this issue. Since 2000, gabapentin, enacarbil, pregabalin, and other medications have been used to treat RLS; however, they are administered less commonly than

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dopaminergic medications. Since 2010, pregabalin, a relatively new medication, has only been the subject of a small number of clinical investigations.[16–18] However, because of their effectiveness and the fact that α2δ ligands have promise for treating RLS because they do not produce enhancement. In 2013, opioids received approval as a second-line treatment for refractory RLS.[19]

The dopaminergic mechanism, iron insufficiency, or genetic imprinting have been the main subjects of studies on the pathogenic processes of RLS.[20–23] Even though dopaminergic medications are effective, nothing is known about how they work to treat RLS. A study using positron emission tomography (PET) revealed that RLS has fewer dopamine transporters,[22] and another PET study suggested that mesolimbic D2/3 receptor binding may be decreased. These findings are corroborated by the finding that pramipexole, a D2/3 receptor agonist, is an effective treatment.[24]

However, postmortem studies of patients with RLS have not shown dopaminergic neurone loss in the substantia nigra (SN) or associated A11 hypothalamic region, which is a characteristic of neurodegenerative disorders like PD that are treated with dopaminergic medications.[25,26] The level of iron in the SN was also observed to be lower in RLS,[26-29] in contrast to PD.[30] The central nervous system's hypoxia pathway is activated by iron deficiency.[31] Tyrosine hydroxylase requires iron as a cofactor, and D2 receptor activity depends on it.[32] RLS may therefore be exacerbated by changes in the dopaminergic systems brought on by iron shortage.

Nineteen RLS risk gene loci were found by a meta-analysis of three genome-wide association studies involving 15,126 patients with RLS.[33] RLS has been linked to rare variations in the *Meis homeobox 1* (*MEIS1*) gene; *MEIS1* has been demonstrated to affect the Early Leg Syndrome (ELS) in mice, pointing to a potential mechanism behind the pathophysiology of RLS.[34] The *BTB domain-containing 9* (*BTBD9*) gene has recently come to light as having a function in the pathophysiology of RLS. Mutations in *BTBD9* are known to be closely linked to an increased risk of RLS.[35] In contrast, animals that have *BTBD9* deletion may exhibit RLS-like symptoms and dopaminergic system malfunction, both of which can lead to the development of RLS.[36] Nevertheless, nothing is known about the mechanisms underlying *BTBD9*. Additionally, new treatments for RLS are being developed, such as adenosine or glutamatergic therapy.[37]

However, not every patient responds well to these drugs, and side effects are associated with every medicine. Consequently, there is a growing need for nonpharmacological treatment.[38] Pregnancy may make RLS worse, which could result in difficulties, including disturbed sleep. Certain RLS drugs might not be suitable for the developing foetus.[39] Increased medication levels and possible negative effects can result from impaired drug excretion in patients with renal failure. Additionally, several RLS drugs may be nephrotoxic.[40] Patients on dialysis are more likely to develop RLS, and dialysis may have an impact on the drugs used to treat it. Additionally, RLS symptoms may intensify due to some dialysis-related diseases.[41]

Before receiving first medical care, nonpharmacological remedies may be considered, or they may be used if the recommended drug is not effective.[42,43]

This study aimed to determine the effect of nonpharmacological treatments like vibration, electric stimulation, acupressure, massage therapy, cryotherapy, and exercise on RLS severity score and sleep quality of patients suffering from RLS.

## Methods

This study was registered by the International Prospective Register of Systematic Reviews (PROSPERO), with registered number CRD42024519014.

### Eligibility criteria

Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines were followed for the selection of studies to be included in the meta-analysis [Figure 1].

The following criteria were used for inclusion:

1. Only human participants were included in this study.
2. Individuals with a confirmed diagnosis of RLS.
3. Analysis of the effect of nonpharmacologic interventions on RLS using only randomised controlled trials (RCTs).
4. Nonpharmacologic interventions studied: "vibration," "electrical stimulation," "acupuncture," "massage," "exercise," and "cryotherapy."
5. Only articles published in the english language were used.

The following were the criteria for exclusion:

1. Studies that focused only on medication without nonpharmacologic intervention.
2. Studies on population other than humans.
3. Studies that lacked sufficient data.
4. Data from studies other than RCTs, such as comments, reviews, and case reports.
5. Studies not published in the English language.

### Information sources and study selection

Many databases, including Google Scholar, Embase, PubMed, and Scopus, were utilized to locate RCTs that were completed no more than 10 years ago as of March 1, 2024. To find new papers, the bibliographies of pertinent articles were also examined.

### Search strategy

The search terms used were "restless leg syndrome" or "RLS severity" as an outcome variable and "nonpharmacological interventions" or "Vibration" or "Electrical stimulation" or "Acupuncture" or "Massage" or "Exercise" or "Cryotherapy" as an exposure variable. The research articles were limited to the English language only. The type of articles included was RCTs only.

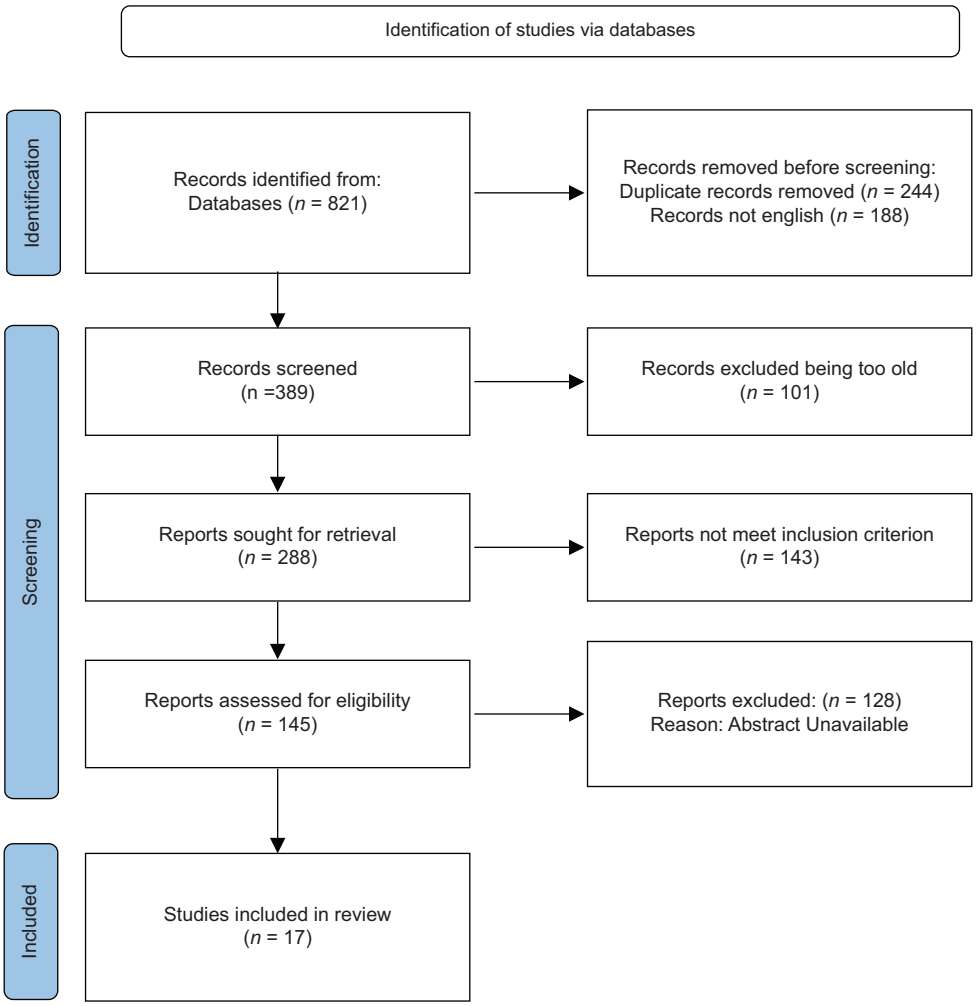



**Figure 1:** PRISMA Flow Diagram. PRISMA: Preferred Reporting Items for Systematic reviews and Meta-Analyses

### Selection process

BG, AT, and RG separately identified all the studies, and any discrepancies were resolved with thorough discussion later. Only the studies including patients with pure RLS syndrome were included.

### Data collection and extraction

The primary author's name, publication year, country of study, the number of participants enrolled, the kind of intervention utilized, and significant findings of the study were extracted from the retrieved publications using a standardized form, as indicated in Table 1.

### Study risk of bias assessment

The analysis employed Cochrane's risk of bias tool 2.0 to evaluate the quality of the incorporated RCTs.[61] The instrument evaluates bias resulting from the randomization procedure, bias resulting from deviations from the planned interventions, bias resulting from incomplete outcome data, bias resulting from outcome measurement, and bias resulting from the choice of the published result. By having in-depth discussions, BG and RG evaluated the possibility of prejudice.

### Data analysis

Standardized mean difference (SMD) figures were employed for all outcomes to assess the impact of every nonpharmacological intervention. Study characteristics are expressed in Table 1. The aggregate effect of each study was expressed using forest plots. For pooling, a random-effects model (REM) was used. The included studies' heterogeneity was evaluated using $I^2$ values. All relevant statistical calculations were carried out using R Studio version 4.3.0.

### Reporting bias assessment

Publication bias was assessed using Egger's test and funnel plots, as shown in Figure 2.

## Results

### Study selection and characteristics

Table 1 lists the attributes of the studies that were included. Among the 17 articles included, 6 are from Iran, 5 from the USA, 2 from Korea, and 1 each from Turkey, Taiwan, Germany, and Australia. RLS was treated with the following types of interventions: exercise (n = 2), massage (n = 2), acupuncture (n = 3), cryotherapy (n = 2), and vibration/stimulation (n = 8).

**Table 1: Study characteristics, organized according to the type of intervention used**

| Author and year of publication | Country, sample size | Type of RLS, duration of therapy | Nature of Intervention, Device Used, and Site of Application | Primary Objective of the Study | Major findings and conclusion |
|---|---|---|---|---|---|
| | | | **1. Vibration/Stimulation** | | |
| Roy et al., 2023[44] | USA, 103 | Primary, 24 weeks | Tonic motor activation, two therapy units worn bilaterally on the lower legs | To evaluate the long-term efficacy and safety of TOMAC for the treatment of medication-refractory moderate-to-severe primary RLS. | TOMAC remained secure and efficient over more than 24 weeks of treatment, with certain advantages partially reverting upon stopping. |
| Bogan RK et al., 2023[45] | USA, 133 | Primary, 8 weeks | Tonic motor activation, two therapy units worn bilaterally on the lower legs | To evaluate the efficacy and safety/tolerability of bilateral high-frequency TOMAC in patients with medication-refractory RLS. | TOMAC was well tolerated, safe, and lowered RLS symptoms in patients who were not responding to treatment. |
| Cho YW et al., 2021[46] | Korea, 46 | Primary, 2 weeks | Electronic Stimulation was administered to the bilateral lower legs using the tapping mode (3 Hz) on a handheld ES device, KD-PRO 5000 GOLD (Kukdong Electronics Co., Ltd). | To investigate the effect of ES as a nonpharmacological treatment for RLS | When the right amounts of stimulation intensity were used during ES treatment, symptoms improved. ES is one nonpharmacological treatment choice for RLS. |
| Buchfuhrer MJ et al., 2021[47] | USA, 37 | Primary, 2 weeks | Noninvasive neuromodulation (electrical stimulation of the peroneal nerve), NPNS system consisted of two configurable, battery-powered, wearable neurostimulation devices, one for each leg | To assess the impact of this NPNS approach on RLS symptomatology | These findings imply that NPNS may be a viable substitute for pharmaceutical treatments for RLS and may offer relief to individuals with medication-resistant RLS, as well as medication-naive patients with RLS who are incapable or unwilling to take medicine. |
| Hosseini H et al., 2017[48] | Iran, 80 | Secondary, 10 min three times per week for four succeeding weeks | Vibration was performed at low voltages (Thrive Model 717 A) for 10 min on the calves | To investigate the effect of vibration on the severity of the manifestation of symptoms of RLS in hemodialysis patients | It is possible to conclude that vibration helps hemodialysis patients experience less severe RLS symptoms based on the study's findings. As a result, it is advised that vibration be applied as a safe, low-cost method to help alleviate RLS symptoms in these individuals. |
| Mitchell UH et al., 2016[49] | USA, 11 | Primary, 2 weeks | Vibration: The subject stood on the vibration platform with knees flexed to about 40 degrees, the weight centered over the middle of each foot. Ten 30-s bouts of WBV at a frequency and amplitude of 26 Hz and 2 mm, respectively, were performed with a 1-min rest while standing between each bout. | To determine if a two-week treatment with whole-body vibration will decrease symptoms associated with RLS/WED | A 2-week treatment with WBV decreases symptoms associated with RLS/WED as measured by the IRLS and RLS-6 questionnaires, but does not normalize skin blood flow in individuals with RLS/WED compared to healthy age-matched controls. |

*Contd...*

**Table 1: Contd...**

| Author and year of publication | Country, sample size | Type of RLS, duration of therapy | Nature of Intervention, Device Used, and Site of Application | Primary Objective of the Study | Major findings and conclusion |
|---|---|---|---|---|---|
| Koo Y.S. et al., 2015[50] | Korea, 33 | Primary, 2 weeks | Battery-driven, constant-current stimulator (Phoresor II Auto Model PM850, IOMED, Salt Lake City, UT, USA). The active electrode was placed on the Vertex. The reference electrode was placed over the suboccipital region, roughly corresponding to the spinous process of the axis. | To evaluate the efficacy of transcranial direct current stimulation (tDCS) in people with drug-naive RLS | Transcranial direct current stimulation with electrodes on the sensorimotor areas showed no significant effect in people with drug-naive RLS. |
| Altunrende B et al., 2014[51] | Turkey, 19 | Primary: One session of intervention was performed once every 3 days, and a total of ten sessions were done in each group. | Transcranial direct current stimulation: A MagPro X100 magnetic stimulator (MagVentura Company, Denmark), connected with a figure-eight coil with an outer diameter of 75 mm, was used to deliver real stimulation, and a coil with an outer diameter of 100 mm was used to deliver sham stimulation, in a double-blinded fashion, to the heads of patients. | To compare the effect of high-frequency rTMS over the supplementary motor area with that of sham stimulation in RLS. | Results showed that high-frequency rTMS over the SMA significantly improved IRLS-RS scores after the 5th and 10th sessions in the real stimulation group; however, this improvement was not seen in the sham stimulation group. |
| | | | **2. Acupressure** | | |
| Tsai et al., 2021[52] | Taiwan, 15 | Secondary, 4 weeks | Acupressure was applied by fingertip rolling (about two or three rollings per second) | To evaluate acupressure's effect on the severity of RLS symptoms and sleep quality in hemodialysis patients with RLS | Acupressure can lessen the intensity of RLS in hemodialysis patients, but it cannot enhance the quality of their sleep. |
| Mohammadi et al., 2018[53] | Iran, 60 | Secondary, 4 weeks | Near-infrared light therapy based on acupoints: sessions were performed using The BioBeam 940 (SyroLight Ltd., Yahud, Israel) light source. | To determine the effect of NIR light therapy given to acupoints on the severity of RLS in patients undergoing hemodialysis | The results of this study demonstrated that hemodialysis patients' RLS symptoms might be effectively reduced by applying NIR light to acupuncture points on their legs and feet. |
| Raissi G et al., 2017[54] | Iran, 46 | Primary, 4 weeks | Acupuncture: Dong Bang disposable 0.25 × 40-mm (diameter × length) sterile steel needles were used. | To examine the additive effect of medical acupuncture on controlling the symptoms of restless legs syndrome. | According to the results of this study, acupuncture combined with a low dosage of gabapentin (300 mg/day) can effectively cure restless legs syndrome in patients with RLS throughout an 8-week follow-up period. It also has a beneficial additive impact beyond that of gabapentin alone. |
| | | | **3. Massage** | | |
| Oshvandi et al., 2021[55] | Iran, 105 | Secondary, 3 weeks | Massage on the foot | To determine the effects of foot massage with lavender and orange essential oils on hemodialysis patients' sleep quality and RLS | It may be suggested that HD patients receive an aromatherapy massage made using lavender oil and sweet orange to improve their quality of sleep and level of RLS. |

*Contd...*

**Table 1: Contd...**

| Author and year of publication | Country and sample size | Type of RLS and duration of therapy | Nature of Intervention, Device Used, and Site of Application | Primary Objective of the Study | Major findings and conclusion |
|---|---|---|---|---|---|
| Mirbagher Ajorpaz et al., 2019[56] | Iran, 90 | Secondary, 4 weeks | Massage using lavender and glycerin oil was performed on both legs. | To determine the effects of glycerin oil and lavender oil massages on hemodialysis patients' RLS. | The results demonstrated how well the oils worked to reduce RLS in several hemodialysis patients using effleurage massage. |
| **4. Cryotherapy** | | | | | |
| Jafarimanesh H., et al., 2020[57] | Iran, 80 | Primary, 2 weeks | Cryotherapy and thermo-therapy were performed by putting the legs in cold and warm water for 10 min | To compare the impacts of two methods of immersion of legs in cold and warm water on RLS symptoms among pregnant women. | Pregnant women's RLS symptoms decreased when they had a cold, as well as when they received warm water treatment. |
| Happe S. et al., 2016[58] | Germany, 35 | Primary, 4 weeks | Cryotherapy: Either whole body cryotherapy (Cold air chamber, Crio-Med) at −60°C (verum group) or −10°C (sham group), or local cryotherapy (Cryo 5, Zimmer Elektromedizin) at −17°C (local group) | To study the efficacy of Whole-body and local cryotherapy in patients with idiopathic RLS. | In addition to standard pharmaceutical treatment, cryotherapy of the entire body at −60°C and, to a smaller extent, local cryotherapy, appears to be a viable treatment option for RLS. It is necessary to determine the precise mechanism of cryotherapy, though. |
| **5. Exercise** | | | | | |
| Cederberg et al., 2021[59] | USA, 15 | Secondary, 16 weeks | Exercise: Participants allocated to the intervention condition were sent instructions on accessing the website, as well as a Yamax Digi Walker SW-200 pedometer and a logbook for recording daily steps through the USPS | To examine the feasibility and efficacy of a physical activity behavior change intervention for improving RLS severity and secondary sleep outcomes among a sample of adults with multiple sclerosis (MS). | We offer early proof of the viability and effectiveness of an exercise program in lowering the severity of RLS. |
| Harrison EG et al., 2018[60] | Australia, 18 | Primary, 6 weeks | Exercise consisted of two parts: 1) preparatory and 2) floor-based exercises | To determine the effect of tension and trauma release exercises on RLS severity compared with discussion group controls | Participating in discussion groups and doing stress and trauma-release activities were linked to comparable results in this exploratory study. Over time, individuals in both groups made comparable progress. |

ES: electronic stimulation, HD: Hemodialysis, IRLS-RS: International Restless Legs Syndrome Study Group Rating Scale, NIR: near-infrared, NPNS: noninvasive peripheral nerve stimulation, RLS: restless legs syndrome, rTMS: repetitive transcranial magnetic stimulation, SMA: Supplementary Motor Area, TOMAC: tonic motor activation, WBV: Whole Body Vibration, WED: Willis-Ekbom Disease

## Risk of bias in studies

The risk of bias is shown in Figure 2. It was found that the overall risk of bias of the included trials was low. Out of all the included trials, 10 studies had a low risk of bias. There were some concerns in 3 of the included studies, and 4 trials had a high risk of bias.

## Results of syntheses

Eight papers included in the current study described how stimulation and vibration affected the severity of RLS. Figure 3.1 showed the forest plot of the effect of all interventions included in this meta-analysis on RLS severity.

As per the heterogeneity test, $P < 0.01$ and $I^2 = 96\%$ were discovered. After that, analysis was done using the REM. The effect of vibration/stimulation on RLS severity was SMD −1.09 (95% CI −2.45 to −0.27) $P < 0.05$. As a result, the RLS severity score significantly decreased ($P < 0.01$) after interventional therapy using vibration/stimulation of the specified kinds.

The effect of acupressure on RLS severity was reported in three publications that were part of the current investigation. According to the heterogeneity test, $P = 0.11$ and $I^2 = 54\%$ were found. Analysis was then conducted using the REM. The meta-analysis results showed that SMD was − 0.87 (95% CI −2.21 to 0.47). Consequently, following interventional treatment with acupressure of the given types, there was a reduction in the RLS severity score.

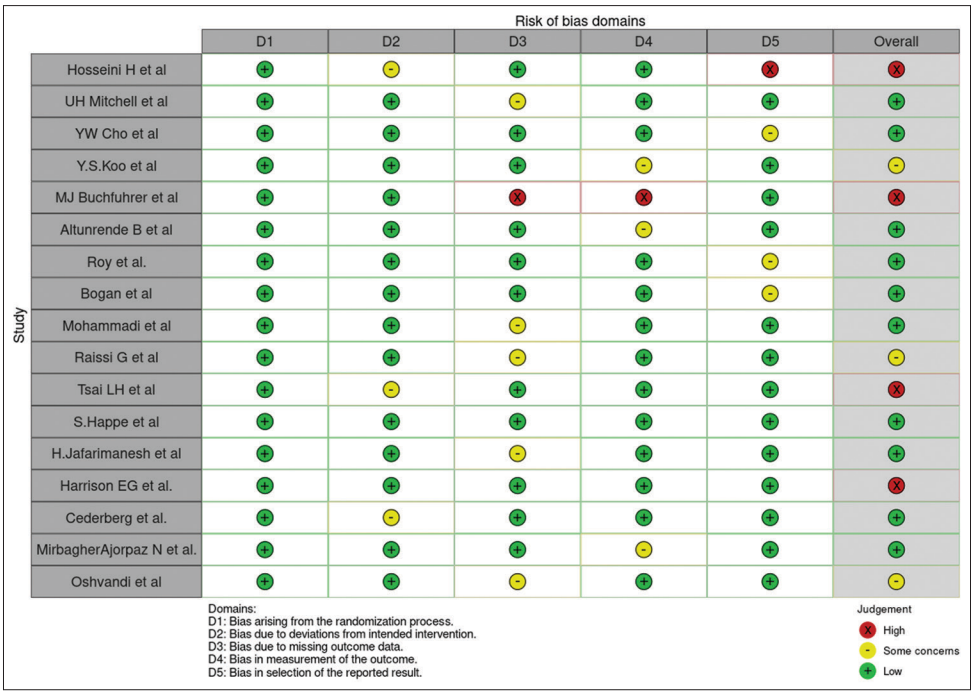



**Figure 2:** Assessment of Risk of Bias in the meta-analysis

The effect of massage therapy on RLS severity was reported in two publications that were part of the current investigation. According to the heterogeneity test, $P = 0.04$ and $I^2 = 76\%$ were found. Analysis was then conducted using the REM. The meta-analysis results showed that SMD (Standardised Mean Difference): -0.87 (95% CI -2.21 to 0.47). Consequently, following interventional treatment with massage therapy of the given types, there was a reduction ($P < 0.01$) in the RLS severity score.

The effect of cryotherapy on RLS severity was reported in two publications that were part of the current investigation. According to the heterogeneity test, $P = 0.29$ and $I^2 = 12\%$ were found. Analysis was then conducted using the REM. The meta-analysis results showed that SMD: −1.27 (95% CI −3.72 to 1.18). Consequently, following interventional treatment with cryotherapy of the given types, there was a reduction in the RLS severity score.

The effect of exercise on RLS severity was reported in two publications that were part of the current investigation. According to the heterogeneity test, $P < 0.01$ and $I^2 = 89\%$ were found. Analysis was then conducted using the REM. The meta-analysis results showed that SMD: −2.05 (95% CI −23.95 to 19.84), $P < 0.01$. Consequently, following interventional treatment with exercise of the given types, there was a significant reduction ($P < 0.01$) in the RLS severity score.

The effect of nonpharmacological interventions on the Pittsburgh Sleep Quality Index (PSQI) was reported in five publications that were part of the current investigation [Figure 3.2]. According to the heterogeneity test, $P = 0.76$ and $I^2 = 0\%$ were found. Analysis was then conducted using the REM. The meta-analysis results showed that SMD: −0.51 (95% CI −0.73 to − 0.28). Consequently, following nonpharmacological interventional treatment, there was improvement in sleep quality.

### Publication Bias and certainty of evidence

The symmetrical funnel chart in Figure 2 indicated that the publication bias was effective in ensuring that the effect of vibration/stimulation, acupressure, massage therapy, cryotherapy, and exercise on the RLS severity score of the patients involved had results above 5k + 10 = 95. Additionally, the majority of the data corresponded to points within the 95% CI [Figure 4].

## Discussion

This meta-analysis was intended to assess the effect of various interventions like vibration, electrical stimulation, acupressure, massage, cryotherapy, and exercise on treating RLS patients. Overall, the analysis comprised a total of 17 RCTs exhibiting the effect of the mentioned interventions on RLS severity and sleep quality.

The majority of studies included patients suffering from primary RLS, while the rest (n = 6) included hemodialysis patients with secondary RLS. RLS severity score was the primary outcome of the study, and sleep quality using the PSQI index was the secondary outcome of the study. Since it was a multinational study, it therefore enhanced the generalizability of the study.

The meta-analysis found a significant improvement in RLS severity score after treatment by vibration, electrical stimulation, acupressure, massage with a variety of oils, cryotherapy, and physical exercises. According to Roy et al.[44] and Bogan et al.,[45] tonic motor activation was found to significantly

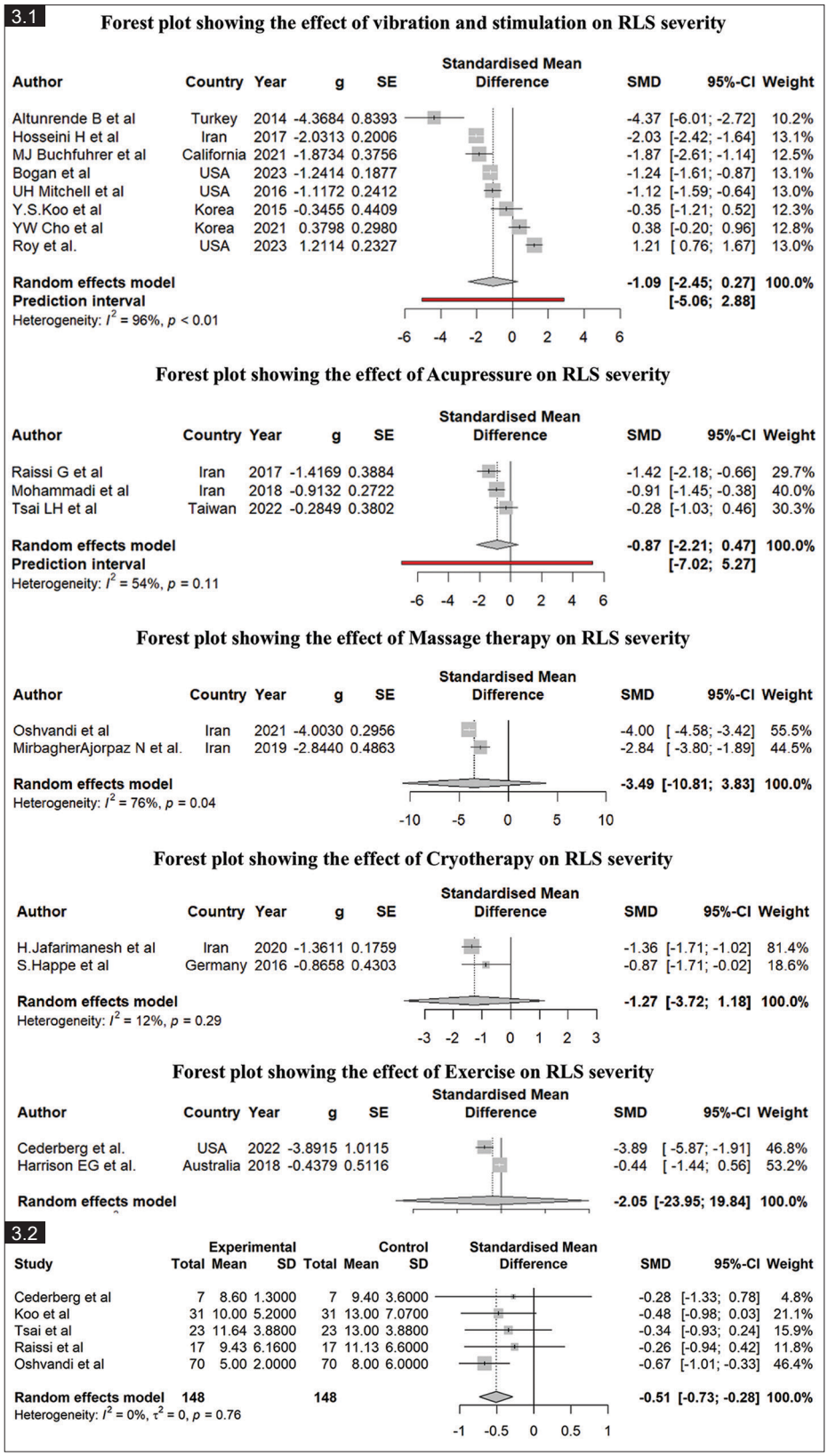



**Figure 3:** (3.1) Effect of various non-pharmacological interventions on the RLS score of patients. (3.2) Effect of non-pharmacological interventions on the Pittsburgh Sleep Quality Index (PSQI) among RLS patients. CI: confidence Interval, RLS: restless legs syndrome, SE: standard error, SMD: standardized mean difference

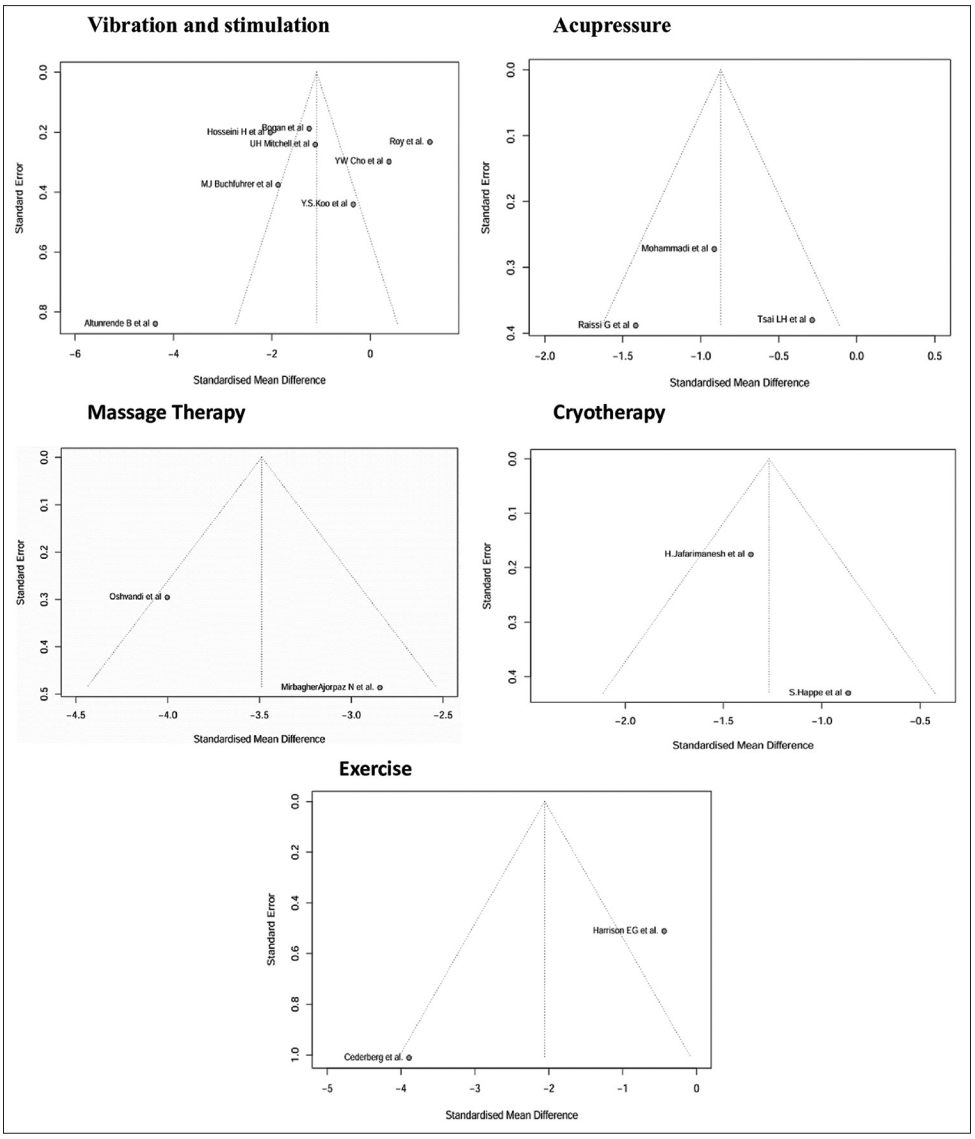



**Figure 4:** Funnel plot showing publication bias in the effect of all intervention on RLS severity. RLS: restless legs syndrome

reduce RLS symptoms. Electronic stimulation (YW Cho et al.) and noninvasive neuromodulation (MJ Buchfuhrer et al.) were effective too.[46,47] Vibration therapy (Hosseini H et al., UH Mitchell et al.) has therefore proven to help in reducing RLS severity through this meta-analysis.[48,49] Other stimulation strategies like transcranial magnetic stimulation (YS Koo et al., Altunrende B et al.) also lead to a reduction in RLS severity.[50,51]

Other than vibration and stimulation, acupressure therapy was found by Tsai et al.,[52] Mohammadi et al.,[53] and Raissi et al.[54] to be beneficial in patients with RLS. A total of 13 bilateral acupoints, including Shenshu (BL23), Ganshu (BL 18), Chengjin (BL 56), Chenshan (BL57), Jinggu (BL 64), Zusanli (ST 36), Liangqiu (ST34), Shangqiu (SP5), Xuehai (SP10), Shanyijiao (SP 6), Taixi (Ki3), Yanglingquan (GB 34), and Xuanzhong (GB 39) were selected.[54] This meta-analysis also found that massage therapy (Oshvandi et al.,[55] Mirbagher Ajorpaz et al.[56]) with a variety of oils reduces symptoms in RLS. Cryotherapy with cold water (H. Jafarimanesh et al.[57]) and reduced temperature (S. Happe et al.[58]) gives relief in aggravating symptoms of RLS. Regular physical activity and supervised exercise (Cederberg et al., Harrison EG et al.)[59,60] lead to increased recovery in RLS severity.

PSQI was used to find out the pooled effect of nonpharmacological interventions on the sleep quality of RLS patients before and after treatment. Five articles reported PSQI after nonpharmacological intervention. The meta-analysis of the same found improvement in sleep quality.

## Strengths and limitations

This preliminary study attempts to measure the usefulness of multiple nonpharmacological interventions as a treatment for RLS in one study. No other study has been able to perform the same. However, the study was not able to present a pooled meta-analysis of a variety of other indices for RLS severity and sleep quality. Dietary interventions are a major part of nonpharmacological intervention in RLS, which have been

completely omitted by the authors. This happened due to the insufficiency of research articles in the mentioned databases about the same.

### Future implications

More research articles need to be published to achieve better clarity on the effect of nonpharmacological interventions on RLS patients who are not responding to pharmacological treatment or are unable to receive the same. More interventions with standard indices need to be incorporated in future publications for a better understanding of the same.

## Conclusions

The study found that there is a significant improvement in the severity score of RLS upon treatment with various nonpharmacological interventions like vibration, electrical stimulation, acupressure, massage, cryotherapy, and exercise.

### Registration and protocol

The International Prospective Register of Systematic Reviews (PROSPERO) registered this study. The registration number of this study is CRD42024519014.

### Author contributions

BG, RG, and KG: the article's idea; layout; and typological reasoning. BG, AM, and KG: data collection and literature selection. BG, RG, and AT: data interpretation and analysis; article editing. BG, AM, and KG: supervision of the study and paper revision. The submitted version of the article was approved by all authors who contributed to it.

### Declaration of non-use of generative AI

The authors affirm that no generative artificial intelligence tools were utilized in the design, analysis, interpretation of data, or preparation of this manuscript. All content is the result of the authors' original work.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

### Data availability statement

The data that support the findings of this study are available from the authors upon reasonable request.

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