

Effects of progressive muscle relaxation therapy on Maintenance hemodialysis patients: a systematic review and meta-analysis

Xiao-Xiao Yang¹, Yuan-Yuan Chen¹, Fan-Jie Meng^{2*}

¹Graduate college, Tianjin University of Traditional Chinese Medicine, Tianjin 301600, China. ²College of Health Engineering, Tianjin University of Traditional Chinese Medicine, Tianjin 301600, China.

*Corresponding to: Fan-Jie Meng, College of Health Engineering, Tianjin University of Traditional Chinese Medicine, No. 10, Poyanghu Road, West Area, Tuanbo New Town, Jinghai District, Tianjin 301617, China. E-mail: mfj127@tjutcm.edu.cn.

Abstract

Objective: This study aimed to evaluate the effects of progressive relaxation therapy on patients with maintenance hemodialysis. **Methods:** A literature search was performed using PubMed, Embase, Cochrane Library, China National Knowledge Infrastructure, and Wanfang Data from inception to July 2020. Randomized controlled trials on the use of progressive muscle relaxation therapy in maintenance hemodialysis patients were selected. The primary outcomes were the depression and anxiety. Secondary outcomes included fatigue and sleep. Two reviewers proceeded study selection and quality assessment of included trials and performed heterogeneity of included studies before meta-analysis. **Results:** A total of 8 studies, which comprised a total of 668 participants were included in the final meta-analysis. The results showed that progressive muscle relaxation therapy could reduce the depression of patients (MD = -5.11, 95% CI: -6.74 to -3.48, $P < 0.001$), reduce the anxiety (SMD = -1.27, 95% CI: -1.73 to -0.82, $P < 0.001$), relieve fatigue symptoms (MD = -0.87, 95% CI: -1.20 to -0.53, $P < 0.001$), improve the sleep quality (MD = -1.69, 95% CI: -1.95 to -1.42, $P < 0.001$). **Conclusion:** Progressive muscle relaxation therapy has positive effects on depression, anxiety, fatigue and sleep quality in patients with maintenance hemodialysis. While concurrent evidence is insufficient, and further studies of high quality are needed to strengthen the conclusion.

Keywords: Progressive Muscle Relaxation therapy, Maintenance hemodialysis, Depression, Anxiety, Fatigue, Meta-analysis

Abbreviations: ESRD, end-stage renal disease; RRT, renal replacement therapy; MHD, maintenance hemodialysis; RCTs, randomized controlled trials; SDS, Self-rating Depression Scale; SAS, Self-rating Anxiety Scale; HARS, Hamilton Anxiety Rating Scale; RPFS, Revised Piper Fatigue Scale; PSQI, Pittsburgh sleep quality index.

Competing interests: The authors declare that there is no conflict of interest.

Citation: Yang XX, Chen YY, Meng FJ. Effects of progressive muscle relaxation therapy on Maintenance Hemodialysis patients: a systematic review and meta-analysis. *TMR Integrative Medicine*. 2021;5:e21003.

Executive Editor: Shan-Shan Lin.

Submitted: 05 September 2020, **Accepted:** 25 September 2020

© 2021 By Authors. Published by TMR Publishing Group Limited. This is an open access article under the CC-BY license (<http://creativecommons.org/licenses/by/4.0/>).

Background

End-stage renal disease (ESRD) is the terminal stage of various chronic renal diseases, which are the irreversible damage of renal function. In recent years, the incidence of ESRD in the world has gradually increased, which has become a public health problem that seriously endangers human health and increases the economic burden [1, 2]. Global Burden of Disease study finds that between 100 and 2,500 people per million people worldwide have ESRD [3]. At present, only renal replacement therapy (RRT) can relieve and treat ESRD clinically, RRT includes kidney transplant and dialysis treatment. Due to the lack of kidney source, the high cost and complications after kidney transplantation, hemodialysis and peritoneal dialysis have become one of the main methods of replacement treatment for patients with end-stage renal disease [4]. Patients with maintenance hemodialysis (MHD) are prone to a variety of psychological disorders due to various conditions such as disease status and economy [5]. Anxiety and depression are the most common and important mental disorders among hemodialysis patients, with adverse effects on the course of disease [6]. It is estimated that the incidence of depression in maintenance hemodialysis patients is 30%–70%, and the incidence of anxiety is 25%–70%, its incidence is much higher than that of the general population [7, 8]. However, depression easily leads to sleeping disorder in patients. According to the survey, the incidence of sleep disorder was 40% to 85%, insomnia can lead to circadian disorders, high blood pressure, high blood sugar and decreased body immunity [9]. It seriously affects the health and easily leads to fatigue of dialysis patients. The prevalence of reported fatigue among the patients undergoing chronic hemodialysis is 60%–97% [10]. Depression and anxiety can damage the physical and mental health of ESRD patients, reduce the quality of life, affect the outcome of the disease, and increase the hospitalization rate and mortality. With the progress of dialysis technology, the survival time of MHD patients is continuously prolonged and their quality of life becomes increasingly important [11]. However, there is no effective solution to the adverse emotions and fatigue of maintenance hemodialysis patients currently. If long-term application of drug treatment, patients will not only become dependent on drugs and have other adverse reactions, but may further increase the renal burden. Therefore, it is very important to take effective non-drug interventions to reduce the negative emotions of hemodialysis patients and relieve their fatigue symptoms.

In recent years, progressive muscle relaxation therapy has been applied in the clinical treatment of a variety of psychosomatic diseases, which have been proved to be effective in improving physiological functions and reduce negative emotions [12, 13].

Moreover, the UK's National Institute of Health and Care Optimization treatment guidelines recommend psychological intervention as first-line treatment before medication. In psychological intervention, progressive muscle relaxation therapy is widely studied and considered to be an effective option for treating adverse emotions [14]. Progressive muscle relaxation therapy as a method of stress management, it is through repeated retraction and relaxation of the muscles to reduce the skeletal muscle tension and sympathetic nerve excitability, to combat the emotional disorder caused by psychological stress, and to achieve the purpose of mental relaxation [15, 16].

Studies have shown that progressive muscle relaxation therapy can improve depression and anxiety in patients with maintenance hemodialysis, and improve fatigue and sleep quality. However, it has not been confirmed by systematic reviews. Therefore, the purpose of this study was to conduct a systematic literature search and critically analyze the available evidence to evaluate the effect of progressive muscle relaxation therapy on alleviating negative mood, fatigue and sleep quality in patients with maintenance hemodialysis.

Methods

Inclusion criteria

Types of study. Randomized controlled trials (RCTs) and pilot studies that applied a randomized controlled design. Non-Chinese and non-English language studies were not included.

Types of participants. Hemodialysis patients aged ≥ 18 years with dialysis duration ≥ 3 months, no limit in the primary disease. Patients with other mental illnesses and those taking other anti-depression and anxiety drugs were excluded.

Types of interventions. The intervention group was treated with progressive muscle relaxation therapy combined with conventional therapy, while the control group was treated with conventional therapy, such as routine clinical monitoring or psychological nursing, etc. Progressive muscle relaxation therapy: the patient recumbent with feet wider than shoulder-width apart, put arms on both sides of the body, palms up, the instructor instructs the patient to take a deep breath in a gentle, slow, quiet tone, and tighten the muscle group 10 s–15 s, relax the muscle group 15 s–20 s, the whole group of 16 muscle group, that is, from bipedal, on to the legs, thighs, hips, waist, abdomen, chest, neck, shoulders, arms, hands, face one by one, complete, focus on each group of muscle contraction and relaxation feeling. Outcome assessment must include one or more of depression, anxiety, fatigue, and sleep quality scores.

Types of outcome measures. Main outcomes: Self-rating Depression Scale (SDS) were used to assess the level of depression; Self-rating Anxiety Scale

(SAS), Hamilton Anxiety Rating Scale (HARS) were used to assess the level of anxiety. Secondary outcomes: Revised Piper Fatigue Scale (RPFS) were used to assess the level of fatigue; Pittsburgh sleep quality index (PSQI) were used to assess the quality of sleep.

Search methods

We searched the following electronic databases from inception to July, 2020: PubMed, Embase, Cochrane Library, China National Knowledge Infrastructure, and Wanfang Data. The following search terms were employed: “progress* muscle relax*”, “progress* relax*”, “progress* relax* train*”, “progress* muscle relax*”, “renal dialys” “hemodialys*”, “extracorporeal dialys*”, “haemodialys*”, “maintained hemodialys*”, “hemotodialys*”, “blood dialys*”, “HD”, “MHD”. Take PubMed as an example, the specific retrieval strategy is shown in [Table 1](#).

Data extraction

Two researchers independently extracted data from the included trials using standardized data extraction tables, including year, author, country, sample size, patient baseline characteristics, treatment duration, interventions and outcomes. Any differences were resolved through discussion.

Risk of bias assessment

The risk of bias in the included studies was assessed by 2 researchers using the Cochrane Collaboration Risk of Bias Tool, for risk assessment of bias in RCTs. Seven items were included: generation of random order, concealment of random scheme allocation, blind method for research objects and intervention implementers, blind method for outcome evaluators,

integrity of outcome indicator data, possibility of selective reporting of research results, and other sources of bias. The evaluator should make a low bias risk, high bias risk and unclear judgment for each project.

Statistical analysis

RevMan 5.3 software was used for meta-analysis of the data. Firstly, the χ^2 test was used to test the heterogeneity between literature results. If the test results were $P > 0.1$ and $I^2 < 50\%$, the fixed effect model was used for meta-analysis. If $P < 0.1$, $I^2 \geq 50\%$, and no clinical heterogeneity was determined, the random effect model was used for meta-analysis. If the source of heterogeneity could not be determined, descriptive studies were used. For continuous data, if the results obtained by the same measuring tool are adopted, the difference in mean is used as the effect analysis statistics. If different measurement tools are used for the same variable, standardized mean difference (SMD) is used as the effect analysis statistic.

Results

Study selection and inclusion process

Through database search, a total of 1,088 potentially relevant studies were identified. Of those, 186 articles were duplicated. Of the remaining 902 articles, 845 were excluded by reading the title and abstract filters. In the remaining 57 articles, through searching and reading the full text, excluding non-randomized controls and research data to obtain fruitless clinical trials, 8 articles were finally included. These 8 articles included a total of 668 patients. Details of the selection process were illustrated in [Figure 1](#).

Table 1 PubMed retrieval strategy

No.	Specific search formula
#1	Progressive muscle relaxation
#2	Progress* relax* OR progress* relax* train* OR progress* muscle relax*
#3	#1 OR #2
#4	Renal Dialys
#5	Hemodialys* OR extracorporeal dialys* OR haemodialys* OR maintained hemodialys* OR hemotodialys* OR blood dialys* OR HD OR MHD
#6	#4 OR #5
#7	#3 AND #6

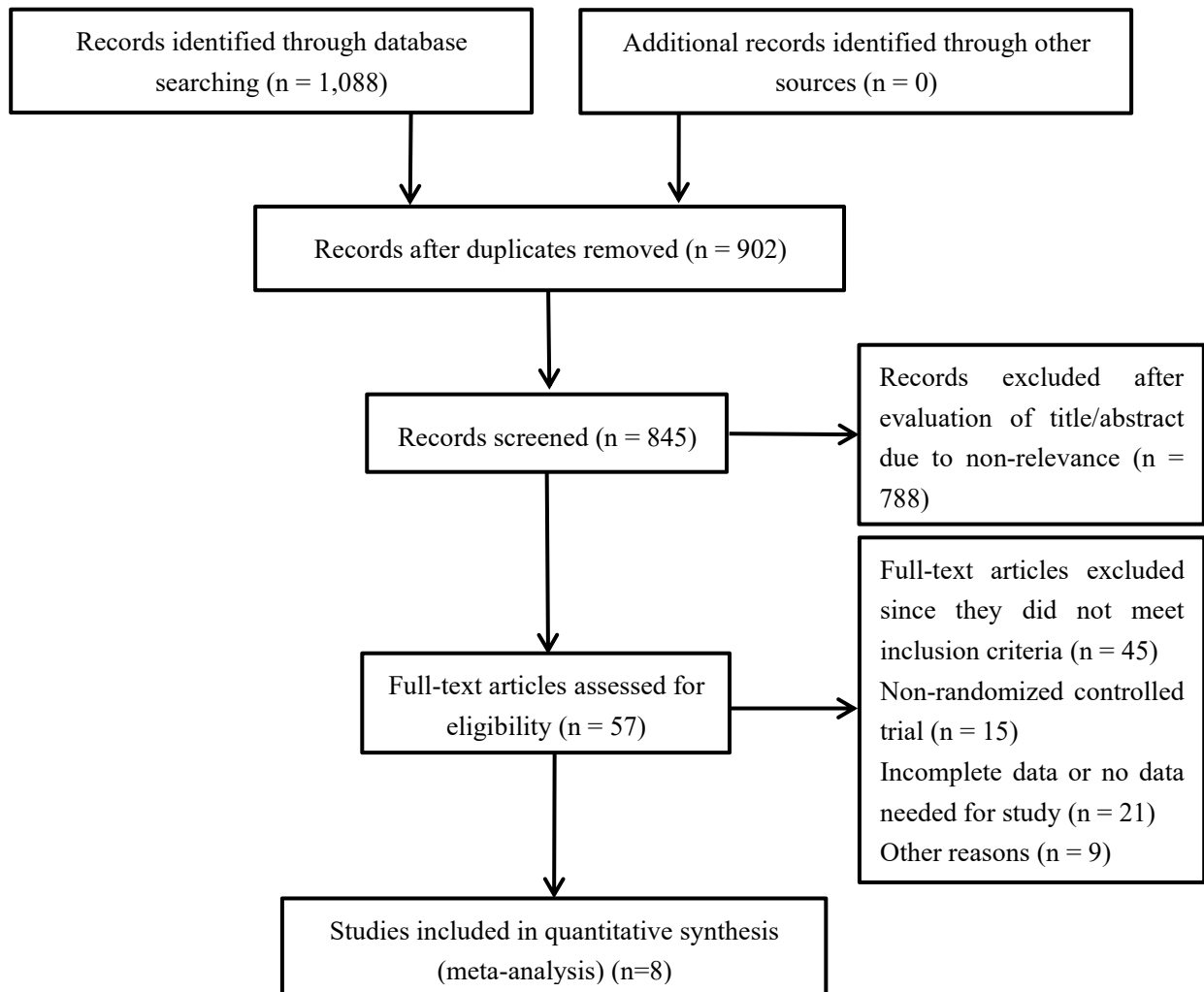


Figure 1 Flowchart of the study

Study characteristics

The included studies were published from 2017 through 2019. The major publishing countries are China (n = 6), Indonesia (n = 1), and Turkey (n = 1). The total duration of the intervention ranged from 4 to 8 weeks, with each intervention lasting from 15 minutes to 40 minutes and the number of interventions per week ranges from 2 to 14. Characteristics of included studies are summarized in Table 2. Most of the patients included in this study were male. The average age of the patients was about 50 years old and the dialysis time varied from 1 to 3 years. There was no incidence of mental illness and the patient's acceptance of dialysis treatment is more acceptable.

Risk of bias assessment

The bias risks of the included studies are shown in Figure 2. Each study reported that patients were randomly divided into experimental and control groups, but only two studies provided details of the

randomization process [21, 22]. None of the 8 studies reported allocation concealment. With regard to selective reporting bias, we judged that expected outcomes were stated in all trials.

Efficacy analysis

Depression. Four articles reported depression symptoms. Results of the heterogeneity test were ($P = 0.07$, $I^2 = 58\%$). Meta-analysis using the random effect model showed that the progressive muscle relaxation therapy group improved patients' depression mood better than the control group, with statistically significant differences (MD = -5.11, 95% CI (-6.74, -3.48), $P < 0.001$) (Figure 3).

Anxiety. Six articles reported anxiety symptoms. SMD was used to standardize the study results. The heterogeneity test results were ($P < 0.001$, $I^2 = 81\%$). Heterogeneity exists between studies, excluding clinical heterogeneity. Meta-analysis using a random effects model showed that the progressive muscle

Table 2 Characteristics of the included studies.

Study/ Location	Number (T/C)	Sex (M/F)	Mean age, years	Intervention	Frequency and duration of intervention	Outcomes
Astuti [17] (2017) Indonesia	39/39	T: 25/14 C: 26/13	T: 48.64 C: 50.07	T: PMR C: deep breathing relaxation techniques	15–30 min/day, 2 times/week, 4 weeks	HARS
Yang [18] (2017) China	43/43	T: 23/20 C: 25/18	T: 35.64 ± 6.27 C: 35.64 ± 6.27	T: PMR + Chinese medicine foot bath C: conventional therapy	40 min/day, 2–3 times/week, 4 weeks	PSQI, SAS, SDS
Guo [19] (2017) China	33/35	41/27	50.35 ± 9.56	T: PMR C: routine hemodialysis care	20–30 min/time, 2 times/day, 8 weeks	PSQI, RPFS
Sun [20] (2017) China	50/50	T: 27/23 C: 28/22	T: 49.82 ± 4.36 C: 49.51 ± 4.32	T: PMR C: conventional therapy	20–30 min/time, 2 times/day, 8 weeks	PSQI, SAS, SDS, RPFS
Sun [21] (2018) China	50/50	T: 31/19 C: 33/17	T: 55.25 ± 9.62 C: 54.76 ± 8.93	T: PMR C: conventional therapy	20–30 min/time, 2 times/day, 8 weeks	PSQI, RPFS, SAS
Zhong [22] (2019) China	30/30	T: 19/11 C: 17/13	T: 48.60 ± 5.29 C: 48.71 ± 5.34	T: PMR C: conventional therapy	20–30 min/time, 2 times/day, 8 weeks	RPFS, PSQI, SAS, SDS
Emine [23] (2019) Turkey	48/48	T: 36/12 C: 27/21	T: 39.1 ± 15.3 C: 49.8 ± 14.1	T: PMR C: routine treatment	30–40 min/day, 7 times/week, 6 weeks	RPFS, SF-36
Lei [24] (2019) China	40/40	46/34	49.86 ± 12.93	T: PMR C: conventional therapy	20–30 min/time, 2 times/day, 8 weeks	PSQI, SAS, SDS

Note: T: experimental group; C: control group; M: male; F: female; PMR: progressive muscle relaxation; PSQI: pittsburgh sleep quality index; HARS: Hamilton Anxiety Rating Scale; SAS: Self-rating Anxiety Scale; SDS: Self-rating Depression Scale; RPFS: Revised Piper Fatigue Scale.

Study	Zhong 2019	Yang 2017	Sun 2018	Sun 2017	Lei 2019	Guo 2017	Emine 2019	Astuti 2017	
Random sequence generation (selection bias)	?	+	?	?	?	+	?	?	
Allocation concealment (selection bias)	?	?	?	?	?	?	?	?	
Blinding of participants and personnel (performance bias)	?	?	?	?	?	?	?	?	
Blinding of outcome assessment (detection bias)	?	?	?	?	?	?	?	?	
Incomplete outcome data (attrition bias)	+	+	+	+	+	+	+	+	
Selective reporting (reporting bias)	+	+	+	+	+	+	+	+	
Other bias	?	?	?	?	?	?	?	?	

Figure 2 Risk of bias summary. Green circles indicate a low risk of bias, yellow circles indicate an unclear risk of bias and red circles indicate a high risk of bias.

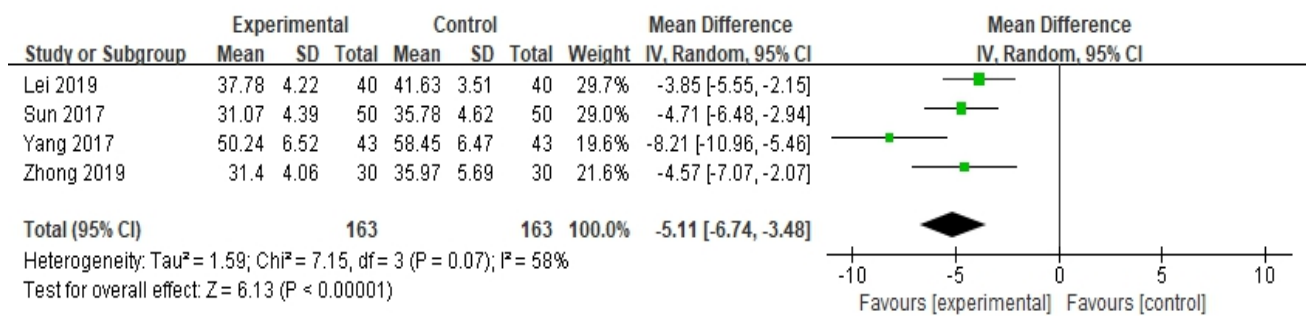


Figure 3 Forest plot for relaxation therapy on depression

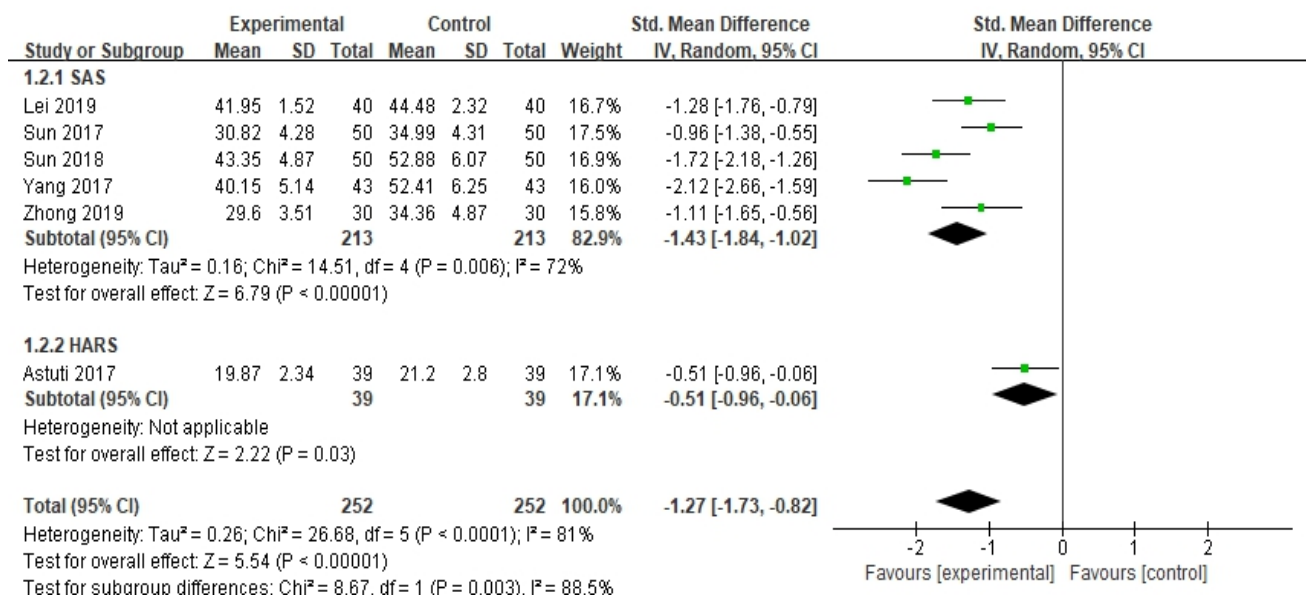


Figure 4 Forest plot for relaxation therapy on anxiety

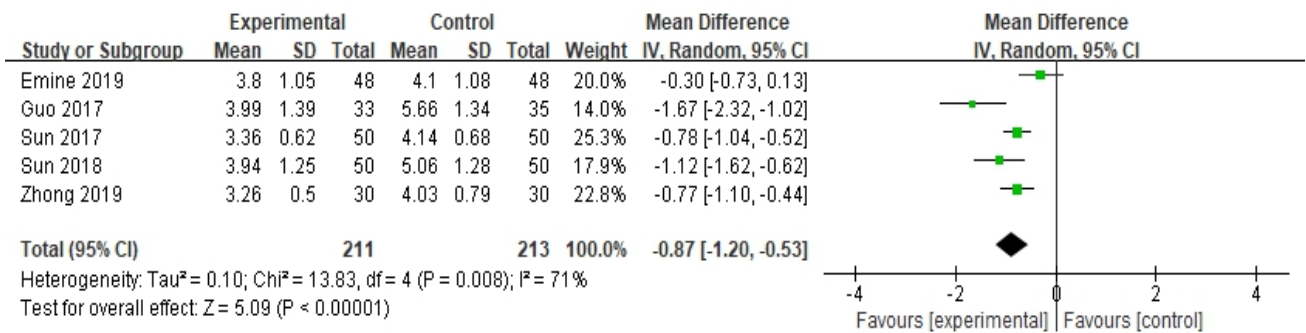


Figure 5 Forest plot for relaxation therapy on fatigue

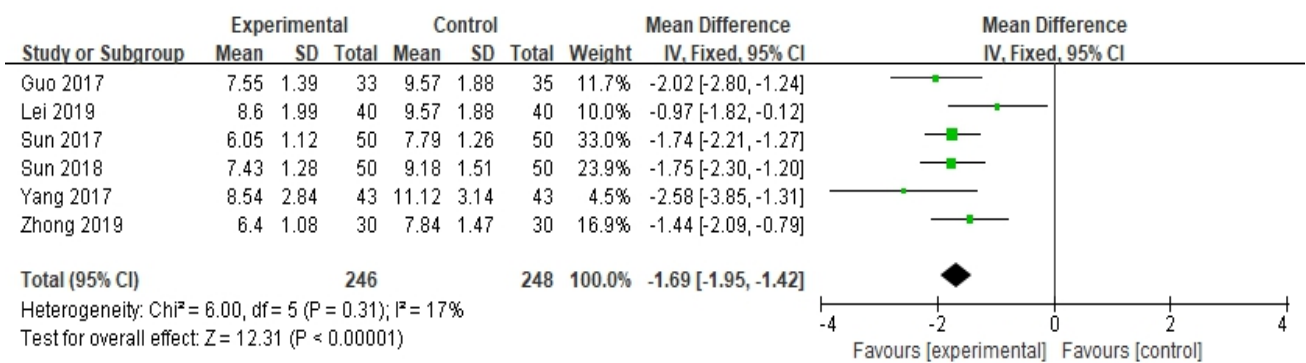


Figure 6 Forest plot for relaxation therapy on sleep

relaxation therapy group improved patients' anxiety mood better than the control group, with a significant difference (SMD = -1.27, 95% CI (-1.73, -0.82), P < 0.001) (Figure 4). Since this study used different scales for measurement, subgroup analysis was used for different scales. Five of the articles used SAS, random effect model results showed that the progressive muscle relaxation treatment group was better than the conventional treatment group in improving anxiety, the difference was statistically significant (SMD = -1.43, 95% CI (-1.84, -1.02), P < 0.001); one article used HARS, random effect model results showed that the progressive muscle relaxation treatment had better effects in improving anxiety than the conventional treatment group, the difference was statistically significant (P = 0.03).

Fatigue. Five articles reported symptoms of fatigue in patients. The heterogeneity test results were (P = 0.008, I² = 71%). Heterogeneity exists between studies, excluding clinical heterogeneity. Meta-analysis using a random effects model showed that the progressive muscle relaxation therapy group improved patients' fatigue state better than the control group, with a significant difference (SMD = -0.87, 95% CI (-1.20, -0.53), P < 0.001) (Figure 5).

Sleep. Six articles used PSQI to evaluate sleep. The heterogeneity test results were (P = 0.31, I² = 17%).

Meta-analysis using the fixed effect model showed that the progressive muscle relaxation therapy group improved patients' sleep better than the control group, with statistically significant differences (MD = -1.69, 95% CI (-1.95, -1.42), P < 0.00001) (Figure 6).

Discussion

Our review of the literature shows that progressive muscle relaxation therapy has been an important research topic in the field of mood, fatigue and sleep relief in maintenance hemodialysis patients. Progressive muscle relaxation technique makes the body consciously tense and relax muscles in accordance with a certain order, so that the individual enters a relaxed state. Thereby, the purpose of relieving psychological tension and reducing physical and mental fatigue is achieved [25, 26]. Progressive muscle relaxation training can reduce the muscle tension of the body skeletal muscle, make body and mind produce euphoric feeling, regulate the psychological function of the human body, and then reduce the anxiety level of patients, improve fatigue [27]. The high treatment cost, long time, many complications and physiological discomfort brought to patients by long-term hemodialysis will have a negative impact on patients' mood, resulting in depression, anxiety and other

adverse emotions [28]. However, negative emotions can not only directly affect the patient's sleep, but also indirectly affect the patient's sleep by enhancing the inflammatory response and its secondary cardiopulmonary dysfunction, which further aggravates the patient's fatigue [29]. Patients with maintenance hemodialysis master relaxation training under the guidance of professionals. Through repeated practice, they learn to consciously control their own psychological and physiological activities, so as to produce a relaxed state, so that the vagus nerve and sympathetic nerve activities are in a good balance state, which can improve the body's ability to resist stress, and adjusts the psychological and physiological dysfunction caused by stress, thereby improving the patient's bad mood, sleeping quality, and alleviating the patient's fatigue [30, 31].

Upon the pooled analysis of all the studies, we found that patients utilizing progressive muscle relaxation techniques experienced a statistically significant as compared to individuals receiving usual nursing care. Studies have shown that depression and anxiety are closely related to the prognosis of maintenance hemodialysis patients. The more severe the degree of depression and anxiety, the worse the prognosis. Therefore, reducing the negative emotions of patients can significantly improve the fatigue and prognosis of patients. Progressive muscle relaxation training is applied more in clinic, itself belongs to a kind of body exercise, its theory thinks individual mood contains "body" and "mood" two parts, it not only can change the response of the body, but also can change the mood [32]. Therefore, the patient consciously controls muscle activity, which can relax emotions indirectly, conducive to relieving negative emotions such as anxiety, fear, depression, and establishing a relaxed mood. Progressive muscle relaxation training improves the quality of life by improving the sleep quality of patients, alleviating negative emotions, regulating psychological functions, and alleviating fatigue symptoms. Progressive muscle relaxation techniques as a non-pharmacological intervention have been widely used in the clinical treatment of anxiety and pain relief. Progressive muscle relaxation technique as a non-pharmacological intervention has been widely used in clinical treatment of adverse mood and pain relief. Ju WX [33] found that progressive muscle relaxation therapy applied to abdominal surgery patients was effective for postoperative pain relief, Kim [34] et al. found that progressive muscle relaxation therapy applied to anxiety patients could significantly improve anxiety symptoms.

This review has several limitations. The strength of any meta-analysis to a certain extent depends on the homogeneity and quality of the studies included. A number of factors limit our reviews ability to draw strong conclusions for progressive muscle relaxation

therapy. Firstly, in this study, only published Chinese and English literature were retrieved, which may lead to publication bias due to incomplete literature collection. Secondly, the content, frequency and duration of each intervention are not consistent, which may have a certain impact on the outcome of the merger and generate a certain risk of bias. Duration of intervention was short, ranging from 4 weeks to 8 weeks, making the long-term effect of MHD patients unknown. Thirdly, most of the included studies showed poor methodological quality based on the Cochrane Collaboration risk bias tool. To some extent, the credibility of the research results was affected; suggests future researchers should strictly ensure the quality of clinical trial methodology, pay attention to the implementation of the scheme of hidden especially blinded, avoid to produce selection and measurement bias. Fourth, due to the insufficient number of trials included in each result, publication bias was not assessed.

Conclusion

The purpose of this study was to determine the efficacy of progressive muscle relaxation therapy in patients on maintenance hemodialysis. The results of this meta-analysis provide evidence that progressive muscle relaxation therapy can reduce anxiety, depression, improve sleep quality and fatigue in maintenance hemodialysis patients. Progressive muscle relaxation training provides a low-cost, low-risk intervention for maintenance hemodialysis patients and is easily accepted by patients, which is worthy of promotion and application in clinical practice. At the same time, more centers, large samples and high-quality randomized controlled trials should be conducted in the future to provide further evidence-based evidence for clinical practice.

References

1. Foley RN, Collins AJ. End-stage renal disease in the United States: an update from the United States Renal Data System. *J Am Soc Nephrol.* 2007;18(10):2644–2648.
2. Ojo A. Addressing the global burden of chronic kidney disease through clinical and translational research. *Trans Am Clin Climatol Assoc.* 2014;125:229–243, 243–246.
3. Luyckx VA, Tonelli M, Stanifer JW. The global burden of kidney disease and the sustainable development goals. *Bull World Health Organ.* 2018;96(6):414–422.
4. Mills KT, Xu Y, Zhang W, et al. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. *Kidney Int.* 2015;88(5):950–957.
5. Feroze U, Martin D, Reina-Patton A,

Submit a manuscript: <https://www.tmrjournals.com/im>

- Kalantar-Zadeh K, Kopple JD. Mental health, depression, and anxiety in patients on maintenance dialysis. *Iran J Kidney Dis.* 2010;4(3):173–180.
6. Turkistani I, Nuqali A, Badawi M, et al. The prevalence of anxiety and depression among end-stage renal disease patients on hemodialysis in Saudi Arabia. *Ren Fail.* 2014;36(10):1510–1515.
 7. Heidari GM, Davanloo AA, Heidarigorji AM. The efficacy of relaxation training on stress, anxiety, and pain perception in hemodialysis patients. *Indian J Nephrol.* 2014;24(6):356–361.
 8. Li YN, Shapiro B, Kim JC, Taibah O, Alserihy O. Association between quality of life and anxiety, depression, physical activity and physical performance in maintenance hemodialysis patients. *Chronic Dis Transl Med.* 2016;2(2):110–119.
 9. Bastos JP, Sousa RB, Nepomuceno LA, et al. Sleep disturbances in patients on maintenance hemodialysis: role of dialysis shift. *Rev Assoc Med Bras (1992).* 2007;53(6):492–496.
 10. Amini E, Goudarzi I, Masoudi R, Ali A, Ali M. Effect of progressive muscle relaxation and aerobic exercise on anxiety, sleep quality, and fatigue in patients with chronic renal failure undergoing hemodialysis. *Int J Pharm Clin Res.* 2016;8(12):1634–1639.
 11. Rambod M, Sharif F, Pourali-Mohammadi N, Pasyar N, Rafii F. Evaluation of the effect of Benson's relaxation technique on pain and quality of life of haemodialysis patients: A randomized controlled trial. *Int J Nurs Stud.* 2014;51(7):964–973.
 12. Ju W, Ren L, Chen J, Du Y. Efficacy of relaxation therapy as an effective nursing intervention for post-operative pain relief in patients undergoing abdominal surgery: a systematic review and meta-analysis. *Exp Ther Med.* 2019;18(4):2909–2916.
 13. Kim HS, Kim EJ. Effects of relaxation therapy on anxiety disorders: a systematic review and meta-analysis. *Arch Psychiatr Nurs.* 2018;32(2):278–284.
 14. Boettcher J, Astrom V, Pahlsson D, Schenström O, Andersson G, Carlbring P. Internet-based mindfulness treatment for anxiety disorders: a randomized controlled trial. *Behav Ther.* 2014;45(2):241–253.
 15. Manzoni GM, Pagnini F, Castelnuovo G, Molinari E. Relaxation training for anxiety: a ten-years systematic review with meta-analysis. *BMC Psychiatry.* 2008;8:41.
 16. Carlson CR, Hoyle RH. Efficacy of abbreviated progressive muscle relaxation training: a quantitative review of behavioral medicine research. *J Consult Clin Psychol.* 1993;61(6):1059–1067.
 17. Astuti A, Anggorowati A, Johan A. Effect of progressive muscular relaxation on anxiety levels in patients with chronic kidney disease undergoing hemodialysis in the general hospital of tugurejo semarang, indonesia. *Bel Nurs J.* 2017;3(4):383–389.
 18. Yang HR, Shi XY, Ye Y, Liu D, Zhang Y. Effect of TCM lavipeditum combined with relaxation training on insomnia, emotional disorders and social function in uremic patients undergoing maintenance hemodialysis. *J Liaoning Univ Tradit Chin Med.* 2017;19(7):162–165.
 19. Guo Q, Qin W, Zhao D. Influence of progressive muscle relaxation training on sleep quality and fatigue in patients of maintenance hemodialysis. *Nurs Res China.* 2017;31(5):1756–1758.
 20. Sun L. Effect of progressive muscle relaxation training on fatigue and sleep quality in patients with maintenance hemodialysis. *Nurs Pract Res.* 2017;14(24):50–51.
 21. Sun XH, Zhang HR. Influences of relaxation training on the sleep quality and the dry weight indexes in the patients undergoing maintenance hemodialysis. *Asia-Pac Tradit Med.* 2018;14(9):200–203.
 22. Zhong N, Li HJ, Peng XC. Effects of staged body relaxation intervention on negative mood, fatigue level and sleep quality in patients with maintenance hemodialysis. *J Yangtze Univ.* 2019;16(10):118–120.
 23. Kaplan SE, Ovayolu N, Ovayolu O. The effect of progressive relaxation exercises on pain, fatigue, and quality of life in dialysis patients. *Holist Nurs Pract.* 2019.
 24. Lei XH, Wang F. Effects of progressive muscle relaxation training on sleep quality and negative mood in patients with maintenance hemodialysis. *J Qilu Nurs.* 2019;25(15):63–65.
 25. DeMarco-Sinatra J. Relaxation training as a holistic nursing intervention. *Holist Nurs Pract.* 2000;14(3):30–39.
 26. Haynes SN, Griffin P, Mooney D, Parise M. Electromyographic biofeedback and relaxation instructions in the treatment of muscle contraction headaches. *Behav Ther.* 1975;6(5):672–678.
 27. Brunelli S, Morone G, Iosa M, et al. Efficacy of progressive muscle relaxation, mental imagery, and phantom exercise training on phantom limb: a randomized controlled trial. *Arch Phys Med Rehabil.* 2015;96(2):181–187.
 28. Li YN, Shapiro B, Kim JC, et al. Association between quality of life and anxiety, depression, physical activity and physical performance in maintenance hemodialysis patients. *Chron Dis Transl Med.* 2016;2(2):110–119.
 29. Flythe JE, Katsanos SL, Hu Y, Kshirsagar AV, Falk RG, Moore CR. Predictors of 30-day

- hospital readmission among maintenance hemodialysis patients: a hospital's perspective. *Clin J Am Soc Nephrol*. 2016;11(6):1005–1014.
30. Wang R, Tang C, Chen X, Ye XQ. Poor sleep and reduced quality of life were associated with symptom distress in patients receiving maintenance hemodialysis. *Health Qual Life Out*. 2016;14(1):125.
 31. Gorji MAH, Davanloo AA, Heidarigorji AM. The efficacy of relaxation training on stress, anxiety, and pain perception in hemodialysis patients. *Indian J Nephrol*. 2014;24(6):356.
 32. Khare KC, Nigam SK. A study of electroencephalogram in mediators. *Indian J Physiol Pharm*. 2000;44(2):173–178.
 33. Ju W, Ren L, Chen J, Du Y. Efficacy of relaxation therapy as an effective nursing intervention for post-operative pain relief in patients undergoing abdominal surgery: a systematic review and meta-analysis. *Exp Ther Med*. 2019;18(4):2909–2916.
 34. Kim H, Kim EJ. Effects of relaxation therapy on anxiety disorders: a systematic review and meta-analysis. *Arch Psychiat Nurs*. 2018;32(2):278–284.