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The effect of acupressure on sleep quality of older people: A systematic review and meta-analysis of randomized controlled trials

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ABSTRACT

Background and Objective: The effects of acupressure on sleep quality and insomnia symptoms have been studied in various groups of haemodialysis patients, those undergoing surgery, and those living in elderly care homes. The aim of this study is to determine the effect of acupressure on sleep quality in elderly people.
Methods: This study was conducted with a systematic review and meta-analysis. In this study, electronic databases of PubMed, Science Direct, National Thesis centre, Google Scholar, Web of Science, EBSCO were systematically scanned between December 2020 and February 2021 using the keywords "older, elderly, sleep quality, acupressure". The study included 11 articles published in English and Turkish languages without any year limitation. This systematic review and meta-analysis were done by following the PRISMA reporting system.
Results: The total sample size of 11 randomized controlled trials included in this systematic review and meta-analysis was 722 (experiment: 363 and control: 359), and the mean duration of acupressure interventions applied was 19.65 ± 11.28 days. The sleep quality of the acupressure group in the elderly was significantly increased compared to the control group (MD: -1.71,%95 CI: -2.31 to -1.11, $Z = 5.60$, $p < 0.00001$, $I^2 = 91\%$). After the subjects received training for acupressure application and applied acupressure themselves, their sleep quality improved compared to the control group (MD: -0.86, 95% CI: -1.39 to -0.32, $p < 0.001$).
Conclusions: We have utilized meta-analysis to try to reveal statistical significance by pooling small studies with high quality. This meta-analysis provided a potentially effective intervention on the quality of sleep in elderly people.

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Introduction

Sleep is one of the most important elements of basic physiological human needs and is a complex rhythmic condition that continuously interacts with the haemodynamics of the individual.[1] Sleep disorders increase with age due to various reasons such as changing daily routines, increasing comorbidities and cellular stress. It has been reported that more than 50% of individuals aged 65 and over in the society have sleep disorders.[2-4] This rate increases up to 70% in the elderly living in nursing homes.[1] Sleep disturbances in the elderly often appear in the form of difficulty falling asleep and maintaining sleep, waking up early in the morning, and frequent sleepiness during the day due to all these.[5] Sleep disturbance in elderly individuals can occur due to many factors including the increased susceptibility to obstructive sleep apnea syndrome because of the increased pharyngeal collapsibility due to aging, age-related prolonged hypercortisolism, disrupted circadian rhythm in melatonin secretion with age, age-related changes in neurotransmitter systems in the cerebral

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cortex, maxillary alveolar hypoplasia and weakened facial musculature due to narrowing of the nasal cavity, to name a few.[6-8] It adversely affects the health-related quality of life by increasing the individual's risk of falling, injury or trauma. Moreover, it is also associated with higher cognitive dysfunction and mortality.[2,5,9]

Benzodiazepines, non-benzodiazepine sedatives and H1 receptor antagonists are recommended for pharmacological treatment of sleep disorders.[10,11] Although these drugs have an important effect in reducing short-term sleep problems, they have various side effects such as severe headache and decreased deep sleep.[9,12] In addition, since these drugs have sedative and anticholinergic properties, side effects such as sleepiness, fatigue, cognitive impairment, falling and respiratory depression can be seen.[9,13]This is why healthcare providers are increasingly turning to non-pharmacological treatments to treat sleep disturbance, especially in elderly people living in nursing homes. Non-pharmacological approaches, including physical activity, light therapy, mind-body applications, sensory interventions, and multicomponent interventions produce promising results.[14]

Different new nursing interventions are being put into practice in increasing the quality of sleep. Today, one of the non-pharmacological methods used to increase sleep quality is acupressure. Included in the Nursing Interventions Classification/NIC, acupressure is a therapy that supports recovery by increasing muscle relaxation and blood circulation in the body.[15-17] Acupressure is a complementary medicine method that ensures proper functioning of energy channels by applying pressure to points on the meridians carrying energy in the body with finger, palm or wrist bands without using a needle. The acupressure mechanism of action works by direct stimulation of interstitial fluid[18] and interstitial connective tissue.[19] Because each body part is supported by certain meridians, pressure is applied to balance the energy flow in the meridian related to that part if there is a problem in a given part of the body. Meridians are divided into yin and yang. Each meridian exists in pairs, right and left. These meridians provide energy flow.[20-22] Widely used acupressure points for sleep, also supported by WHO are Shenmen (HT7), Sanyinjiao (SP6), Neiguan (PC6) and Yongquan (KI1). Rhythmic stimulations created with sufficient physical pressure at these determined points create a response in the interstitial flow. Thus, mechanical, bioelectrical and/or biochemical signals are carried through the interstitial connective tissue. The effect of acupressure on sleep is explained by the release of endorphins, changes in the central and peripheral nervous system, and regulation of cytokine and neurotransmitter release. Acupressure stimulates the release of serotonin, a neurotransmitter substance. Serotonin provides regulation of mood, sleep and muscle contractions. Serotonin signals activate the secretion of melatonin from the pineal region of the brain, which reduces nocturia-related wakefulness and shortens the time to fall asleep while increasing total sleep duration and sleep quality. Acupressure stimulation regulates parasympathetic nervous system activity, which increases sleep quality by increasing autonomic responses and reducing psychological stress[23,24] Since it is not invasive, it involves minimal risk and can therefore be used easily in nursing practices.[25,26]

Early detection of sleep problems and appropriate interventions to improve sleep quality are very important, because prolonged sleep disturbances can impair haemodynamics, increase frailty and thus reduce quality of life.[2] Insomnia causes daytime sleepiness, cognitive impairment, increased risk of accidents, mood disorders, and deterioration in quality of life in elderly individuals.[27] In addition, because elderly individuals are more sensitive and vulnerable to drug-related side effects, the use of multiple drugs (polypharmacy) in the elderly can lead to a decrease in the quality of life, an increase in health expenditures, poorer patient compliance and even death. Thus, improving sleep quality with non-pharmacological approaches will protect the patient from possible drug-drug interactions.[28] Studies conducted to prevent symptoms related to insomnia mention the importance of acupressure application. The effects of acupressure on sleep quality and insomnia symptoms have been studied in various groups of haemodialysis patients, those undergoing surgery, and those living in elderly care homes.[2,29,30] There is a need for more studies examining the effect of acupressure, on sleep quality, especially in individuals aged 65 and over who need complementary medical support. The aim of this study is to analyze the effectiveness of acupressure, which is applied to increase sleep quality in elderly individuals, in randomized controlled studies.

Methods

The PRISMA Statement (PRISMA Statement-Systematic Review or Checklist for Items to be Found in the Meta-Analysis report) was followed in the preparation and reporting of this systematic compilation and meta-analysis, which was conducted to determine the effectiveness of acupressure applied to increase sleep quality in elderly individuals.[31] The review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) Registry CRD42021231001

Eligibility criteria

Eleven studies published in Turkish and English between 1999 and 2020 were included in this study. Studies eligible for this systematic review and meta-analysis, performed independently by the first and second researchers (BD, DI), met the following criteria (PICOS):

Population: Individuals aged 65 and over without cognitive dysfunction.

Intervention: acupressure treatment

Comparison: control group (without acupressure treatment)

Outcomes: Sleep quality measured by the Pittsburgh Sleep Quality Index (PSQI): Developed by Buysse et al. in 1989,[32] PUKI is a 19-item self-report scale that evaluates sleep quality and disturbance in the past month. It consists of 24 questions: 19 questions are self-report questions, and 5 questions are answered by the spouse or roommate. The 18 scored questions of the scale involve 7 components: Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficiency, Sleep Disorder, Sleeping Medicine Use, and Daytime Dysfunction. Each component is given a score between 0 and 3. The total score of the 7 components gives the scale total score, which may range from 0 to 21. A total score greater than 5 indicates "poor sleep quality."

Study Design: Randomized controlled trial.

Reviews, case reports, qualitative studies and congress reports, studies published in languages other than Turkish and English, and studies in which sleep quality was not measured were not included in the study.

Search strategy

Web of Science, PubMed, Science Direct, Google Scholar, Google Scholar, Ebsco, Cochrane Central Register of Controlled Trials, and National Thesis Center search engines were scanned between December 2020 and February 2021 to access articles in the research period. Medical subject headings (MeSH), which contain the words older, elderly, sleep quality, acupressure, was combined with the keywords "or" and "and".

Study selection

The studies for this systematic review and meta-analysis were identified and selected by the first and second researchers (BD, DI) independently, according to the title, abstract and full text, respectively, based on the inclusion criteria. When there was a difference of opinion about any study, two researchers came together to discuss and reach an agreement. The bibliography of the included studies

was scanned in order to reach the studies that can be included. The PRISMA flowchart regarding the selection process of the studies is given in Fig. 1.

Data extraction and bias risk assessment

The standard data extraction tool developed by the researchers was used to obtain the research data. In this data extraction tool, data on study design and purpose, year of study, sample size, participant characteristics, intervention and duration, practitioner, sleep quality measurement tool, country where the study was conducted, and sleep quality measurement results were collected. This process was done independently by the first and second investigators and was controlled by the third investigator. The resulting data were determined for meta-analysis to examine the effectiveness of acupressure. Finally, full-text articles meeting the inclusion criteria were reviewed and the remaining 11 articles were included in the review (Fig. 1). The results of the systematic searches were imported to a reference manager, Endnote software. Duplicates were removed using the software and by hand (BD; Dİ; Gİ). The JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies, developed by the Joanna Briggs Institute, was used to evaluate the methodological quality of research.[33] There are 8 questions in this checklist and the questions are answered as “Yes”, “No”, “Uncertain” or “Not Applicable”. In addition, the bias risk of the randomized controlled study was evaluated according to the Cochrane Handbook for Systematic Reviews of Interventions (34).[34] This approach used a “high risk”, “uncertain risk” and “low risk” scoring approach to judge the following: (a) random method adopted, (b) allocation hidden, (c) blind method of implementer and participant, (d) ending blindness, (e) incomplete outcome data, (f) selective reporting bias and (g) other biases. Quality assessment results are given in Fig. 2.

Publication bias was analysed with the Egger test, the result of which was t: 0.95 and p:0.48. As a result of this analysis, there was no significant publication bias in the included studies.

Data synthesis

The findings of the studies included in the study were analysed with Reviewer Manager version 5.4.1. Inter-study heterogeneity was evaluated by the Higgins I^2 test and random effects model was used since I^2 was > 50% and $p < 0.001$. The 95% Confidence Interval (CI) was calculated for each outcome variable. All tests were calculated as two-tailed and a p value of less than 0.05 was considered statistically significant.

Results

Search results

As a result of the screening, 1.671.563 articles were initially reached. Reviews by title, summary, and full text, respectively, and removal of repeating records yielded 47 articles. Excluding studies published in different languages, performed in different populations

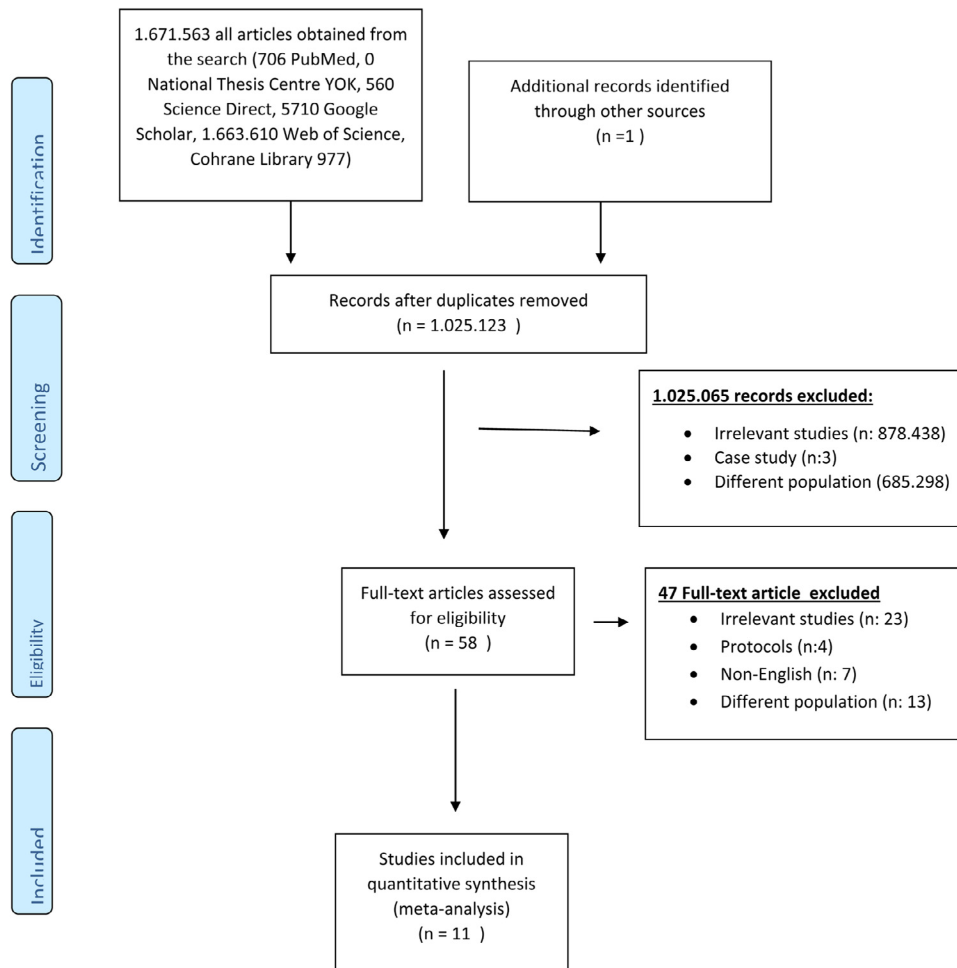

Fig. 1. PRISMA 2009 flow diagram.

	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
Chan 2017	+	?	−	+	+	+	?
Chen 1999	+	?	−	+	+	+	?
Chen 2019	+	+	+	+	+	+	?
Lai 2017	+	+	+	+	+	+	+
Lo 2013	?	−	−	?	?	?	?
Lu 2013	+	?	−	?	+	+	?
Molassiotis 2020	+	+	+	+	+	+	+
Reza 2010	+	?	−	−	+	+	?
Xiao-Fang 2015	+	?	−	+	+	+	?
Zeng 2016	+	?	−	−	+	+	?
Zheng 2014	+	−	−	+	+	+	?

Fig. 2. Quality of risk assessment.

and different study protocols resulted in 11 articles. Data were collected from 11 randomized controlled trials using the data extraction tool. Explanations about the selection of the articles are shown in Fig. 1.

Risk of bias

All randomized controlled trials clearly met the allocation randomization but only 3 studies[35-37] adopted allocation concealment. Eight of the studies did not blind the subject or research staff to intervention allocation.[2,38-44] However, acupressure application is not suitable for blinding because of how it is applied. Therefore, performance bias is seen in these studies. Seven studies clearly report the blinding of the outcome.[35-38,42,44,45] In eight studies, it was stated that the experimental and control groups had the same characteristics. In addition, validly and reliably scales were used and appropriate statistical analyzes were made in all the studies. The completion rate of the acupressure intervention ranged from 89% to%100 in 11 RCTs. Only 27.2% of the studies[36-38] reported that intention the treat analyses was used.[36-38] In addition to other possible risk of bias, we assessed the compliance bias risk (Fig.2).

Study characteristics

The total of the samples of the 11 studies included in the meta-analysis was 722 (experiment: 363 and control: 359), and the average intervention time was 19.65 ± 11.28 days. Eleven studies were published in English. Five studies were performed in China,[37,38,42-44] 5 studies in Taiwan[16,36,39-41] and 1 study in Iran.[2] The duration of pressure applied to the acupuncture points ranged from 4 to 40 min, with the 15-minute session being the most common. The frequency of acupuncture sessions varied: once a day, twice a day, four times a day, six times a week, five times a week, four times a week, three times a week, and twice a week. The total duration of the acupuncture intervention ranged from 10 days to 1 year and was most frequently administered for a 4-week period (8 studies). The Shenmen point was used in 72.7% of the studies. The baseline characteristics of all studies were recorded (Table 1). Post intervention results of the studies were included.

Acupressure intervention

The application of acupuncture procedures and techniques varied between studies. In five studies, acupuncture was performed by researchers, practitioners, or trained assistants. In six studies, participants were trained in acupressure techniques and subjects self-administered acupressure. Finger or thumb pressure was used in most of the studies. The procedure started with massage or warm-up activities, and then pressure was applied to selected acupuncture points. Finger pressure with a circular or rotational motion was applied in two studies[36,41] and facial massage in one.[42] In other studies, figures or thumb pressure or massage were used on each acupoint.

The effect of acupressure application on sleep quality

The results of the meta-analysis of the 10 studies examining the effectiveness of acupressure applied to the elderly are shown in Table 2. The combined results of these studies have shown that acupressure positively affects sleep quality in elderly individuals (MD: −1.71,%95 CI: −2.31 to −1.11, $Z = 4.62$, $p < 0.00001$, $I^2 = 91\%$, Table 2).

When elderly individuals were trained for acupressure application and the results of the studies in which the participants applied acupressure themselves were pooled, it was seen that acupressure positively affected the sleep quality of elderly individuals (MD: −0.86,%95 CI: −1.39 to −0.32, $Z = 3.16$, $p < 0.00001$, $I^2 = 85\%$, Table 3).

Studies with experimental and sham groups examining the effect of acupressure on sleep quality in elderly individuals found that acupressure had a positive effect on sleep quality compared to the sham group. (MD: −1.82, 95% CI: −2.55 to −1.09, $Z = 4.87$, $p < 0.00001$, I2 = 87%, Table 4).

Discussion

The combined results of 11 randomized controlled trials examining the effect of acupressure on sleep quality in elderly individuals were presented in this meta-analysis. According to the data obtained, acupressure is a potentially effective intervention on the quality of sleep in the elderly. Trainings of acupressure given to elderly people increased their sleep quality. Health professionals can improve the sleep quality of elderly people by both providing training about acupressure and applying this inexpensive and easy to use therapy.

Acupressure is a method used by traditional Chinese medicine for sleep disorders.[16] This non-invasive method is easy to learn and safe to apply.[46] In their systematic review and meta-analysis studies consisting of different patient groups (haemodialysis patients, elderly people living in the nursing home and menopausal women), Chen et al. concluded that the sleep quality of the patients who received acupressure was better compared to the control group.[47] In their systematic review, Fischer et al. stated that acupressure improves sleep quality, can be applied as a complementary and alternative treatment in addition to pharmacological treatment, and that it is a safe, well-

Table 1
The methodological characteristics of the included studies.

Number	Study details First author, date of publication, country	Patients characteristics Main diagnosis or population, mean age	Study design Design Sample size = experimental/ sham/control	Outcome	Intervention Experimental group Mode of acupressure, [applied acupoints], pressure weight, duration of acupressure, frequency of treatment, duration of treatment	Sham/Control Procedure	Results Before the interventions	Results After the interventions	Study conclusion
1	Chen et al. 2019, Taiwan	Nursing home residents with poor sleep quality	Prospective, randomized, double-blind, sham-controlled trial 31\ 31	PSQI MMSE K-10	receiving acupressure at true acupoints (Baihui, Juque, Neiguan, Tianzhu, and Yongchung), 20 min of acupressure before sleeping 3 times a week for 8 weeks	The control group received sham acupressure and usual care	PSQI Experimental: 14.1 ± 2.8 Sham: 13.1 ± 1.9 K-10 Experimental: 24.8 ± 7.8 Control: 22.8 ± 6.6	PSQI Experimental: 8.3 ± 1.8 ($p<0.001$) Sham: 14.2 ± 2.3 ($p<0.001$) K-10 Experimental: 14.6 ± 6.0 ($p<0.001$) Sham: 17.9 ± 6.9 ($p = 0.05$)	The experimental group demonstrated significantly more improvement in sleep quality than did the control group at the end of the intervention (10.5 vs 13.3) and 1 month after the intervention (8.3 vs 14.2; both P 0.001). Acupressure at true acupoints improves sleep quality
2	Lo et al. 2013, Taiwan	Older female adults	Randomized, single-blind, experimental-controlled, parallel-group 14/13	PSQI PSG	Auricular points on [Semen Vaccariae], 1.6 mm diameter, pressed 7 s and relaxed 1 second 12–15 min, 3/day, 3 week	No additional force applied to the magnetic pellets	PSQI Experimental: 13.40± 2.90 Control: 13.69±1.97 ($p>0.05$) PSG Sleep Efficiency Experimental: 79.58± 7.54 Control: 76.99±12.62 ($p>0.05$)	PSQI Experimental: 5.07±2.63 Control: 9.23±3.63 ($p<0.05$) PSG Sleep Efficiency Experimental: 84.04± 4.62 Control: 72.15±12.78 ($p<0.001$)	After intervention, the mean global score of PSQI reached significant difference between groups, indicating that sleep quality of the experimental group improved more than that of the control group. After intervention, sleep efficiency was increased, sleep latency and arousal index were decreased significantly in the experimental group.
3	Chan et al. 2017, China	Older people living in the community	A randomised controlled trial with waitlist control design 54/52	PSQI WHOQOL-BREF GDS	Traditional Chinese Medicine (TCM) principle guided, 15 min, 4/week, 12 consecutive weeks	Received as a care-as-usual	PSQI Experimental: 9.31 ± 4.31 Control: 8.21±4.28 ($p>0.05$) WHOQOLBREF Experimental: 3.49±0.78 Control: 3.54±0.79 ($p>0.05$) GDS Experimental: 4.53±3.32 Control: 4.01±3.29 ($p>0.05$)	PSQI Experimental: 7.83 ± 4.38 Control: 9.42 ± 4.57 ($p<0.05$) WHOQOLBREF Experimental:3.70±0.64 Control: 3.45±0.71 ($p>0.05$) GDS Experimental: 3.39±3.46 Control: 4.26±3.64 ($p<0.05$)	Study's findings have presented a viable non-pharmacological treatment to improve the sleep quality of the frail older people. The biggest single item change in WHOQOLBREF was also in the physical domain. Significant reduction of the GDS score indicated that the acupressure protocol had also made a positive impact on the psychological well-being of the participants.
4	Zeng et al. 2016, China	Older adults with impaired sleep quality	A randomised controlled trial 42/40	PSQI ESS MMSE	Face, hand and foot on [Anmian, Neiguan, Shenmen, Sanyinjiao], The precision of acupressure was confirmed if participants felt sore, numb, heavy, distended, or warm, 30 min, 1/week, 3 week	Received sleep health instructions in three sessions over 3 consecutive weeks by a community health staff.	PSQI Experimental: 8.83±3.9 Control: 9.10±4.1 ($p>0.05$) ESS Experimental: 4.86±3.67 Control: 4.53±3.97 ($p>0.05$) MMSE Experimental: 24.36± 3.23 Control: 23.38±3.99 ($p>0.05$)	PSQI Experimental: 5.7 ± 2.3 Control: 10.6 ± 3.9 ($p<0.001$)	The interaction effect of time/intervention was significant for PSQI and ESS ($p < 0.001$). indicating that the intervention group scores on the sleep measures showed more improvement over time than the control group.

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Table 1 (*Continued*)

Number	Study details First author, date of publication, country	Patients characteristics Main diagnosis or population, mean age	Study design Design Sample size = experimental/sham/control	Outcome	Intervention Experimental group Mode of acupressure, [applied acupoints], pressure weight, duration of acupressure, frequency of treatment, duration of treatment	Sham/Control Procedure	Results Before the interventions	Results After the interventions	Study conclusion
5	Xiao-fang et al. 2015, China	Elderly patients with hypertension	A randomised controlled trial 34/34	PSQI MMSE	Face, hand and foot on: Rou-kneading Anmian, Taiyang, Shenmen, Fengchi, Rou-kneading Neiguan, Rou-kneading Sanyinjiao [Extra, located at the midpoint between Yiming (EX-HN 14) and Fengchi (GB 20), EX-HN 5, HT 7, GB 20, PC 6, SP 6] Massage manipulations needed to be mild and strength intensity needed to be appropriate, each one at least 40 to 50 times, 4/day, 3 months	Received the same guidance of mental health and education of sleep knowledge as those in the treatment group once per week.	PSQI Experimental: 9.09±1.24 Control: 9.06±1.10 ($p>0.05$) MMSE Experimental: 24.39±2.23 Control: 24.27±2.20 ($p>0.05$)	PSQI Experimental: 7.35±1.47 Control: 8.85±1.10 ($p<0.001$) MMSE Experimental: 26.78±2.02 Control: 24.67±2.52 ($p>0.001$)	Patients in the treatment group obtained better effect in sleep improvement than those in the control group. Patients in the treatment group obtained better effect in cognitive function than those in the control group
6	Lai et al. 2017, Taiwan	Older Nursing home residents	A randomized control trial with a pre- and post-test design 31/31	PSQI SF-36	Face, hand and foot on [Tian-Zhu (BL10), Ju-Que (CV14), Yong-Quan (KI1), Bai Hui (DU20), and NeiGuan (P6)], 3–5 kg, 24 min, 3/week, 8 week	Massage at locations with no acupoints, which were 10 mm from the true points, at 3/week, 8 week	PSQI Experimental: 13.23±3.97 Sham-Control: 13.19±2.53 ($p>0.05$) SF-36 Experimental: 67.26±5.60 Sham-Control: 68.35±10.25 ($p>0.05$)	PSQI Experimental: 7.32±1.92 Control: 13.45±2.82 ($p<0.001$) SF-36 Experimental: 74.23±5.20 Control: 67.78±10.66 ($p<0.05$)	Compared to the control group, the experimental group had significantly better scores on the PSQI and SF-36 after the intervention.
7	Reza et al. 2010, Iran	Nursing home residents	A randomized controlled clinical trial 25/26/26	PSQI	Face, hand and foot on [Neiguan, Shenmen(HT7), Yungchuan(K11), Sanyinjiao (SP6), Anmian] 3–4 kg,	Sham: non-acupoints which were 0.5 cmm away from meridian Control: received just routine care	PSQI Experimental: 11.88±2.53 Sham: 11.58±3.24 Control: 11.46±2.97 ($p>0.05$)	PSQI Experimental: 6.84±2.79 Sham: 9.54± 4.25 Control: 11.69± 2.85 ($p<0.05$)	The analysis of data showed significant differences in Global scores of PSQI among three groups. There is significant difference in Global scores of PSQI between the acupressure group and the control group, but there was no difference between the sham acupressure group and the control group.
8	Chen et al. 1999, Taiwan	ICU patients	A randomized block experimental 28/28/28	PSQI	Hands-on, [HT7, Ear Shenmen, GV20, Anmian], 3–4 kg, 15 min, 5/wk, 3 wk	Sham: 1 cm to true acupoints Control: conversation only	PSQI Experimental: 1.79±2.62 Sham: 12.75±2.46 Control: 12.71±237 ($p>0.05$)	PSQI (pre-post mean) Experimental: 6.86±2.62 Sham: 11.07±2.46 Control: 12.32±2.37 ($p<0.05$)	There is no significant difference in PSQI scores between pre-intervention groups. There is a significant difference in PSQI scores between groups after the intervention. Acupressure group's PSQI score is better than all other groups.
9	Lu et al. 2013, Taiwan	Psychogeriatric inpatients	A randomized controlled clinical trial 30/30	PSQI Actigraphy	Hands and foot on [Shenmen, Yangchuan, Neiguan], 3–5 kg, 9 min, daily, 4 weeks	Standard medical care and assessments	PSQI Experimental: 15.53±1.69 Control: 15.04±1.10 ($p>0.05$)	PSQI Experimental: 6.36±1.70 Control: 13.90±0.97 ($p<0.001$)	Participants in the experimental group improved significantly in subjective sleep quality as measured by the PSQI and in objective sleep quality as measured by actigraph (Sleep latency, total sleep time, sleep efficiency, wake episodes, wake time).

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Table 1 (*Continued*)

Number	Study details First author, date of publication, country	Patients characteristics Main diagnosis or population, mean age	Study design Design Sample size = experimental/ sham/control	Outcome	Intervention Experimental group Mode of acupressure, [applied acupoints], pressure weight, duration of acupressure, frequency of treatment, duration of treatment	Sham/Control Procedure	Results Before the interventions	Results After the interventions	Study conclusion
10	Zheng et al. 2014, China	Elderly patients with hypertension	A randomized controlled clinical trial 38/37	PSQI Blood pressure	Hand and foot on [Shenmen, Taixi] the force was strengthened gradually till the patient felt soreness, 40 min, daily, 4 weeks	Routine care	PSQI Experimental: 12.16±2.8 Control: 11.68±3.12 ($p>0.05$) SBP/DBP Experimental:136.21± 11.9/78.37±9.49 Control: 133.08±11.39 /78.86±8.91 ($p>0.05$)	PSQI Experimental: 7.37±3.98 Control: 9.81±3.76 ($p<0.001$) SBP/DBP Experimental:118.61±6.6 /73.47±7.17 Control: 132.73±12.22 /76.92±8.45 ($p<0.001$)	After four weeks of intervention, the total PSQI score in the experimental group was significantly lower compared to the control group. After the intervention, SBP and DBP of the experimental group decreased significantly.
11	Molassiotis et al. 2020, Hong Kong	Older people with depression living in the community	A randomised sham-controlled trial 27/35/22	PSQI GDS GHQ-12	Both limbs on [Stomach 36 (ST36); Liver 3 (LIV3), Heart 7 (HE7); Lung 1 (LU1); and Governor Vessel 20 (GV20)], the therapist/caregiver held firm pressure until it “hurt good”, 9 min, 4/week, 12 weeks	Sham: acupressure points were acupoints different from the meridians and ganglionic section. Control group: received treatment as usual only.	PSQI Experimental: 12.7 ± 0.6 Sham: 14.3 ± 0.6 Control: 13.8 ± 0.7 ($p>0.05$) GDS Experimental: 10.6 ± 03 Sham: 10.5 ± 0.3 Control: 10.8 ± 0.4 ($p>0.05$) GHQ-12 Experimental: 18.8 ± 0.9 Sham: 19.3 ± 1.0 Control: 18.3 ± 1.0 ($p>0.05$)	PSQI Experimental: 12.7 ± 0.7 Sham: 13.7 ± 0.7 Control: 14.1 ± 0.8 ($p>0.05$) GDS Experimental: 7.7 ± 0.7 Sham: 8.4 ± 0.8 Control: 9.9 ± 0.7 ($p<0.05$) GHQ-12 Experimental: 15.3 ± 1.0 Sham: 14.4 ± 0.7 Control: 16.3 ± 1.0 ($p<0.05$)	Sleep dysfunction (PSQI score) was similar across all three groups. The GDS scores in the experimental and sham groups were significantly reduced at post-intervention. Minor mental health disorders (measured by the GHQ) showed significant reductions in all three groups. At the 3-month follow-up, GHQ scores significantly increased in the experimental group but not the other two groups.

PSQI: Pittsburgh Sleep Quality Index; PSG: Polysomnography; PLM: Sleep Apnoea and Periodic Limb Movements; GDS: Geriatric Depression Scale; ESS: Epworth Sleepiness Scale; MMSE: Mini-Mental State Examination; SF-36: Short-form 36; GHQ-12: The General Health Questionnaire; K-10: Kessler Psychological Distress scale.

Table 2
The effect of acupressure on sleep quality between experimental and control group.

	Experimental			Control			Std. Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Lu et al., (2013)	6.36	1.7	30	13.9	0.97	30	8.1%	−5.38 [−6.49. −4.26]
Chen et al., (1999)	6.86	2.36	28	12.32	2.37	28	9.9%	−2.28 [−2.69. −1.59]
Lai et al., (2017)	7.32	1.92	31	13.23	3.97	31	10.1%	−1.87 [−2.47. −1.27]
Molassiotis et al., (2020)	12.7	0.7	40	14.1	0.8	38	10.4%	−1.85 [−2.38. −1.31]
Reza et al., (2010)	6.86	2.79	25	11.69	2.85	26	10.0%	−1.69 [−2.34. −1.05]
Zeng et al., (2016)	5.7	2.3	42	10.6	4.09	40	10.5%	−1.47 [−1.96. −0.98]
Lo et al., (2013)	5.07	2.63	14	9.23	3.63	13	9.2%	−1.28 [−2.12. −0.44]
Xiao-Fang et al., (2015)	7.35	1.47	34	8.85	1.1	34	10.4%	−1.14 [−1.66. −0.63]
Zheng et al., (2014)	7.37	3.98	38	9.81	3.76	37	10.6%	−0.62 [−1.09. −0.16]
Chan et al., (2017)	7.83	4.38	50	9.42	3.9	51	10.8%	−0.38 [−0.77. 0.01]
Total (95% CI)			**332**			**328**	**100.0%**	**−1.71 [−2.31. −1.11]**

Heterogeneity: $Tau^2 = 0.82$, $Chi^2 = 97.84$, df = 9, $I^2 = 91\%$.
Test for overall effect: $Z = 5.60$.

Table 3
Application of acupressure – Subgroup analyzes.

	Experimental			Control			Std. Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Molassiotis et al., (2020)	12.7	0.7	40	14.1	1.8	38	16.7%	−1.85 [−2.38. −1.31]
Lo et al., (2013)	5.07	2.63	14	9.23	3.63	13	13.3%	−1.28 [−2.12. −0.44]
Xiao-Fang et al., (2015)	7.35	1.47	34	8.85	1.1	34	16.9%	−1.24 [−1.66. −0.63]
Zheng et al., (2014)	7.37	3.98	38	9.81	3.76	37	17.4%	−0.62 [−1.09. −0.16]
Chan et al., (2017)	7.83	4.38	50	9.42	4.57	51	18.1%	−0.35 [−0.75. 0.04]
Zeng et al., (2016)	8.83	3.91	42	9.1	4.09	40	17.7%	−0.07 [−0.50. 0.37]
Total (95% CI)			**218**			**213**	**100.0%**	**−0.86 [−1.39. −0.32]**

Heterogeneity: $Tau^2 = 0.37$; $Chi^2 = 33.64$, df = 5, $I^2 = 85\%$.
Test for overall effect: $Z = 3.16$.

Table 4
The effect of acupressure on sleep quality between experimental and sham group.

	Experimental			Control			Std. Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Chen et al., (2019)	8.3	1.8	31	14.2	2.3	31	19.0%	−2.82 [−3.54. −2.11]
Lai et al., (2017)	7.32	1.92	31	13.45	2.82	31	19.4%	−2.51 [−3.18. −1.83]
Chen et al., (1999)	6.86	2.36	28	11.07	2.32	28	19.8%	−1.77 [−2.40. −1.15]
Molassiotis et al., (2020)	12.7	0.7	40	13.7	0.7	40	21.0%	−1.41 [−1.91. −0.92]
Reza et al., (2010)	6.84	2.79	25	9.54	4.25	40	20.8%	−0.71 [−1.22. −0.19]
Total (95% CI)			**155**			**170**	**100.0%**	**−1.82 [−2.55. −1.09]**

Heterogeneity: $Tau^2 = 0.60$; $Chi^2 = 30.35$. df = 4; $I^2 = 87\%$.
Test for overall effect: $Z = 4.87$.

tolerated and highly acceptable method that can be applied alongside routine care.[48] In another systematic review examining the effect of acupressure on sleep quality in elderly individuals, it was stated that acupressure had a positive effect on sleep quality and that acupressure was a cost-effective, non-invasive method with minimal side effects, and it can be applied easily.[35] Results that support these studies with high value of evidence were obtained in this meta-analysis.

Four of the studies included in the meta-analysis involved a sham acupressure group. The sham acupressure group is the group in which sham acupressure is applied to an area other than the meridian points. Three of these studies[2,37,39] had 3 separate groups as experiment, control and sham groups, while in one [Chen IH, 2019] the control group was the sham group. In the study of Molassiotis et al., acupressure had no effect on sleep quality in both the sham and acupressure groups.[37] In studies conducted by Chan et al. in China[37] and by Chen et al.[39] in Taiwan, acupressure application increased sleep quality, while this effect was not observed in the sham group. In the study of Reza et al., acupressure application increased sleep quality in the sham group, although not as much as in the acupressure group.[2]

When the studies evaluating the findings of the use of sleeping pills after the acupressure application of the elderly are examined, it was stated in 3 studies[2,39,41] that the frequency of sleeping medication use did not change between the groups after acupressure application, and 2 studies[36,49] reported that use of sleeping pills decreased after the intervention compared to the control group. In fact, in the study of Lai et al., this decrease was shown to continue for up to 4 weeks. Evaluation of drug use is important for studies. Considering polypharmacy in elderly individuals, improving sleep quality with non-pharmacological methods could protect the patient from possible drug-drug interactions. In some studies, the lack of change in the use of sleeping pills can be associated with possible dependence on sleeping pills, which are considered as a side effect of pharmacological treatments for sleep problems. It is currently not known whether a reduction in the use of sleeping pills will be seen with studies involving longer intervention period and follow-up. No adverse effects have been reported with acupressure in studies so far, which suggests it is a safe intervention, especially compared to pharmacotherapies.[26] Therefore, we think it is important to perform acupuncture regularly to maintain this effect.

This meta-analysis concluded that acupressure was beneficial in elderly individuals who applied it themselves. Another meta-analysis investigating the effect of acupressure on sleep quality evaluated 13 studies and reported no statistical difference in the effectiveness of acupressure among the types of acupuncture applications (hands-on, self-acupressure or wristband) or between the elderly and young people. The same study noted that the significant heterogeneity within subgroups does not allow to draw conclusive conclusions about the effects of this interaction, and self-administered acupressure is likely perceived as less invasive and less stressful. Acupressure therapy self-administered by patients will probably benefit elderly individuals in terms of long-term applicability and self-motivation.

Traditionally, the pressure is adjusted according to the patient's feedback on sensations during the treatment session. As the protocol for acupressure, it is recommended in the literature to apply a pressure of 3–5 kg for at least one minute to each compression point over 20 min or more.[26,47] Also, there should be the HT7 (Shenmen) point between acupuncture points. Of the studies included in this meta-analysis, only three applied both the HT7 point and a pressure of 3–5 kg.[2,39,41] There is a need for trainings for practitioners in order for acupressure applications to be performed correctly and effectively.

Limitations

The first limitation of this study is that only the studies published in Turkish and English languages were included, while the studies in other languages were excluded. Due to language restrictions, we did not include the databases of Korea and Japan, where acupressure practice is the most common, which could have potentially contributed to more evidence-based knowledge. This weakens our work. In addition, it is not possible to generalize the study to the elderly population worldwide. However, interventions were distinct in duration, timing, frequency, and especially in acupoints although Shenmen is dominant. Also, heterogeneity in the inclusion criteria of participants across the included studies may also be limitation as it is not clear if some participants had sleep complaints/disorders or were healthy individuals. Another limitation is that the full texts of the studies could not be accessed while searching the literature. In such cases, the authors were tried to be reached via e-mail, but they sometimes responded late or did not respond at all. This is considered as a limitation for the study as it caused data loss for the meta-analysis. Another limitation is that the sample did not consist exclusively of elderly individuals in most of the studies reached, and the experimental methods of some studies were not suitable. Since these cause data losses for the meta-analysis, they were considered as a limitation and they increased heterogeneity.

Implications for future research

We believe that paying attention to and reporting random sequence and allocation concealment for randomized controlled studies will improve the results in future studies. When it is not possible to blind patients and staff, censoring and blinding the allocation of outcome evaluators may be an appropriate approach to avoid selection bias and detection bias. We anticipate that the use of the intention-to-treat analysis method, which includes all randomized participants in the randomly assigned groups regardless of withdrawal from the study or deviation from the protocol, in the data analysis will also improve the results. Moreover, most of the studies were conducted in Asian countries, with only one study conducted in Italy. More studies on acupressure should be performed in western societies to determine the applicability and effects of acupressure in different cultural communities. The search in our country's databases for relevant studies did not yield any randomized controlled studies conducted in Turkey. There is also a need for population studies in Turkey. In addition to all these, the number of studies on self-administered acupressure is limited in the literature and more studies are needed. During the application of acupressure, the factors that may affect the application and the application protocol should be carefully examined and reported properly.

Conclusion

Acupressure is a simple and easy to learn, non-invasive technique. This meta-analysis showed that acupressure has the potential to improve sleep quality. This study combined quite different RCTs in interventions. Study results can provide evidence-based advice for patients, caregivers and decision-makers in elderly care areas and encourage further research with appropriate methodology. Healthcare professionals, caregivers, family members and patients themselves can learn and practice this simple acupuncture technique. Integrating acupressure into the care of elderly people will improve their sleep quality and well-being. This can further reduce the costs and side effects of drug therapy. Better care can be provided to patients in clinics if health professionals providing holistic care to patients make use of acupressure. Acupressure will also help prevent physiological and psychological complications that may occur in elderly individuals whose sleep quality is impaired. Since acupressure is a non-invasive, safe and effective method, it can be used to increase both the sleep quality and quality of life of the elderly. However, more studies that will increase the level of evidence regarding the efficacy of acupressure will contribute to the literature. More

systematic reviews and meta-analyses are needed to provide more conclusive evidence for the use of acupressure to improve sleep quality.

Contributions

The authors have confirmed that all of the authors meet the ICMJE criteria for authorship credit (www.icmje.org/ethical_1author.html), as follows: (Conceptualization (BD; Dİ; Gİ; NB; EY; AA; MVK; AK; GÖ), Data curation (BD; Dİ; AK), Formal analysis: (BD; Dİ), Methodology (BD; Dİ; Gİ; NB; MVK), Resources (BD; Dİ; AK; GÖ), Writing (BD; Dİ; Gİ; NB; EY; AA; MVK; AK; GÖ), Original draft (BD; Gİ; AA; EY; AK), Review & editing (BD; Dİ; Gİ; NB)) drafting the article or revising it critically for important intellectual content.

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Availability of data and materials

The data and materials described in the manuscript can be freely available to any scientist wishing to use them for non-commercial purposes.

Conflict of interest

The authors would like to declare that there is no issue related to conflict of interest for this study.

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