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Systematic Review

Sleep hygiene education as a treatment of insomnia: a systematic review and meta-analysis

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Abstract

Background. Sleep hygiene education (SHE) is commonly used as a treatment of insomnia in general practice. Whether SHE or cognitive-behavioural therapy for insomnia (CBT-I), a treatment with stronger evidence base, should be provided first remains unclear.
Objective. To review the efficacy of SHE for poor sleep or insomnia.
Methods. We systematically searched six key electronic databases up until May 2017. Two researchers independently selected relevant publications, extracted data and evaluated methodological quality according to the Cochrane criteria.
Results. Twelve of 15 studies compared SHE with CBT-I, three with mindfulness-based therapy, but none with sham or no treatment. General knowledge about sleep, substance use, regular exercise and bedroom arrangement were commonly covered; sleep-wake regularity and avoidance of daytime naps in seven programs, but stress management in only five programs. Major findings include (i) there were significant pre- to post-treatment improvements following SHE, with small to medium effect size; (ii) SHE was significantly less efficacious than CBT-I, with difference in effect size ranging from medium to large; (iii) pre- to post-treatment improvement and SHE-CBT-I difference averaged at 5% and 8% in sleep-diary-derived sleep efficiency, respectively, and two points in Pittsburgh Sleep Quality Index; (iv) only subjective measures were significant and (v) no data on acceptability, adherence, understanding and cost-effectiveness.
Conclusions. Although SHE is less effective than CBT-I, unanswered methodological and implementation issues prevent a firm conclusion to be made on whether SHE has a role in a stepped-care model for insomnia in primary care.

Key words: Sleep hygiene education, cognitive-behavioural therapy, psychological intervention, systematic review, meta-analysis, insomnia.

Introduction

Insomnia is a highly prevalent condition that is associated with substantial distress, psychosocial impairment and medical and psychiatric morbidity (1). Patients with sleep problems consult their general practitioners more frequently than other health professionals (2) and typically prefer non-pharmacological treatments (3), among which sleep hygiene education (SHE) is the most commonly used (4). The term 'sleep hygiene' was first used by Peter Hauri in 1977 in the context of providing recommendations for patients with insomnia (5,6). The list of sleep hygiene recommendations was updated in 1991 (5), and many versions are now available (7). In a recent review (8), Irish *et al.* reported that caffeine, tobacco and alcohol use, exercise, stress, noise, sleep timing and daytime napping are the areas commonly covered during SHE. Whether SHE should be given priority for treating insomnia remains a controversy due to its low cost and easy availability. A review paper published in the American Family Physician (9) placed SHE equivalent to cognitive-behavioural therapy for insomnia (CBT-I), but the recommendation was based on consensus and usual practice (Strength-of-Recommendation Taxonomy grade C), while the American Academy of Sleep Medicine Report in 2006 (10) and a clinical guideline published in the Journal of Clinical Sleep Medicine in 2008 (11) did not support SHE as a single therapy due to insufficient evidence (No recommendation level). Recent literature further supports the effectiveness of CBT-I, e.g. an evidence report by the American College of Physicians considered CBT-I as an effective intervention for insomnia disorder (moderate-strength evidence) (12) and the Australasian Sleep Association guideline placed CBT-I as a first line treatment (Level I evidence from meta-analyses) (13).

General practitioners seldom conduct CBT-I or refer patients with insomnia for psychological treatment (14,15). Although verbal advice and a sleep hygiene sheet are often used (14), they are seen to be insufficient to address the sleep problem by most general practitioners (15). A stepped-care model has been proposed by Espie as a solution to the high demand of CBT-I services (16). The model is often conceptualized as a pyramid, of which high patient volume is managed at the base of the pyramid using low intensity treatments, e.g. self-help CBT-I, with progressively smaller volumes and greater expertise in assessment and treatment towards the top step. Although self-help CBT-I has a strong evidence base for its effectiveness (17), it contains more information and may be harder to understand than sleep hygiene recommendations; hence is worthwhile to explore whether SHE can be a starting point for the treatment of insomnia.

To our knowledge, there has been no systematic review on SHE. The last review was published in 2003 and did not follow systematic protocol (7). Since SHE is commonly used in healthcare settings and many studies may have been published on SHE, the aim of this systematic review and meta-analysis is to examine whether SHE is an effective treatment and how SHE compares to CBT-I and other forms of treatments for insomnia.

Method

Literature search

The meta-analysis was conducted with reference to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) (18). The protocol was registered at the International prospective register of systematic reviews (CRD42015024995). The Ovid MEDLINE, EMBASE, CINAHL plus, PsycINFO and Dissertation & Thesis A&I and Cochrane Library from inception through 30 June 2015 were searched without language restriction using the search terms: (sleep hygiene OR sleep education OR sleep health) AND (random* OR controlled trial OR clinical trial OR RCT) AND (sleep OR insomnia OR dyssomnia) in titles or abstracts. An updated search was conducted in June 2017 for publications up to 31 May 2017. Reference lists of the included studies and relevant reviews were examined for additional articles. As a forward search, we used the Ovid MEDLINE to identify all papers that have cited the included studies.

Study selection

Studies included in this review are randomized controlled trials that examined participants with a complaint of poor sleep or insomnia who received SHE in comparison with no treatment, routine care, placebo or sham treatment or any forms of psychological, pharmacological, complementary or alternative medicine treatment. Supplementary Table 1 presents the population intervention comparison outcome (PICO) protocol. SHE was defined as any advice provided to patients with an intention to help their sleep without any elements of CBT-I (including stimulus control, sleep restriction, relaxation training and cognitive therapy) or other complementary and alternative medicine components (e.g. Taichi, qigong, massage, acupressure). We did not set any specifications for delivery modality, treatment content and duration, outcome measure or study quality. Two investigators selected relevant publications independently according to the eligibility criteria. Any disagreement was resolved by thorough discussion and consultation with the senior author (KC). When a study had more than one patient group (e.g. one group of primary insomnia and another group of comorbid insomnia), we considered it twice as two different comparisons. When the same group of authors published more than one article using data from the same group of subjects, we considered it as one set of comparison and used the largest dataset that was available.

Data extraction and quality assessment

One investigator extracted the data and another checked the extracted data. For each study, the following variables were extracted: study design, subjects' characteristics including age, gender, duration and diagnosis of insomnia, components and procedure of SHE, comparison intervention and outcome parameters. Primary outcome was sleep questionnaire score, but other outcomes, such as sleep diary, actigraphy and polysomnography-derived variables were also recorded if available. We analyzed the quality of studies using the Cochrane's risks of bias assessment (19), which has six domains: random sequence generation, allocation concealment, blinding of participants, personnel and outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias. The ratings of each domain can be 'yes' (low risk of bias), 'no' (high risk of bias) or 'unclear' (uncertain risk).

Data synthesis and analysis

We used the Comprehensive meta-analysis software version 3.0 for statistical analysis. The summary measures were the mean difference and its 95% confidence interval (CI) and effect size, calculated as Hedges's *g*. We analyzed the pre- to post-treatment improvements and between-group differences in outcomes. Due to differences in demographic characteristics and inclusion and exclusion criteria between studies, it was expected that there was heterogeneity a priori; hence the random-effects model and inverse-variance method were employed to calculate summary estimates (20). Heterogeneity was

evaluated using the Cochrane's Q statistic, with P value < 0.10 indicating significant heterogeneity. The I^2 statistic was computed as a compliment to the Q statistic. As suggested by Higgins *et al.* (21), I^2 of 0%, 25%, 50% and 75% indicate no, low, moderate and high heterogeneity, respectively. If there were 10 or more studies in a comparison, publication bias would be examined by visual inspection of the funnel plot, which is a scatterplot of treatment effect against sample size. Sensitivity analysis was performed using the leave-one-out method in order to investigate the influence of outlying studies on the synthesized effect size in the random-effects model (22). Subgroup analyses were performed to determine the impact of insomnia nature (primary versus comorbid), delivery modality (in-person versus printed material) and the number of SHE sessions (1–2 versus ≥ 3). The chosen factors were considered having potential impact on treatment outcome.

Results

Identification of studies

Figure 1 presents the flowchart of the systematic review. A total of 2361 entries were included for title and abstract screening and 133 papers were selected for full-text screening. Fifteen studies met the eligibility criteria and were included in this review (23–37).

Overview of the included studies

Table 1 summarizes the characteristics of the 15 included studies. Sample size was typically small, ranging from 20 to 159, with a total of 1194 subjects. About 52.8% were female and the mean age was 65.6 years. CBT-I was the most common comparator (n = 12), followed by mindfulness-based treatment (n = 3), while no studies compared SHE with placebo or sham treatment, treatment as usual,

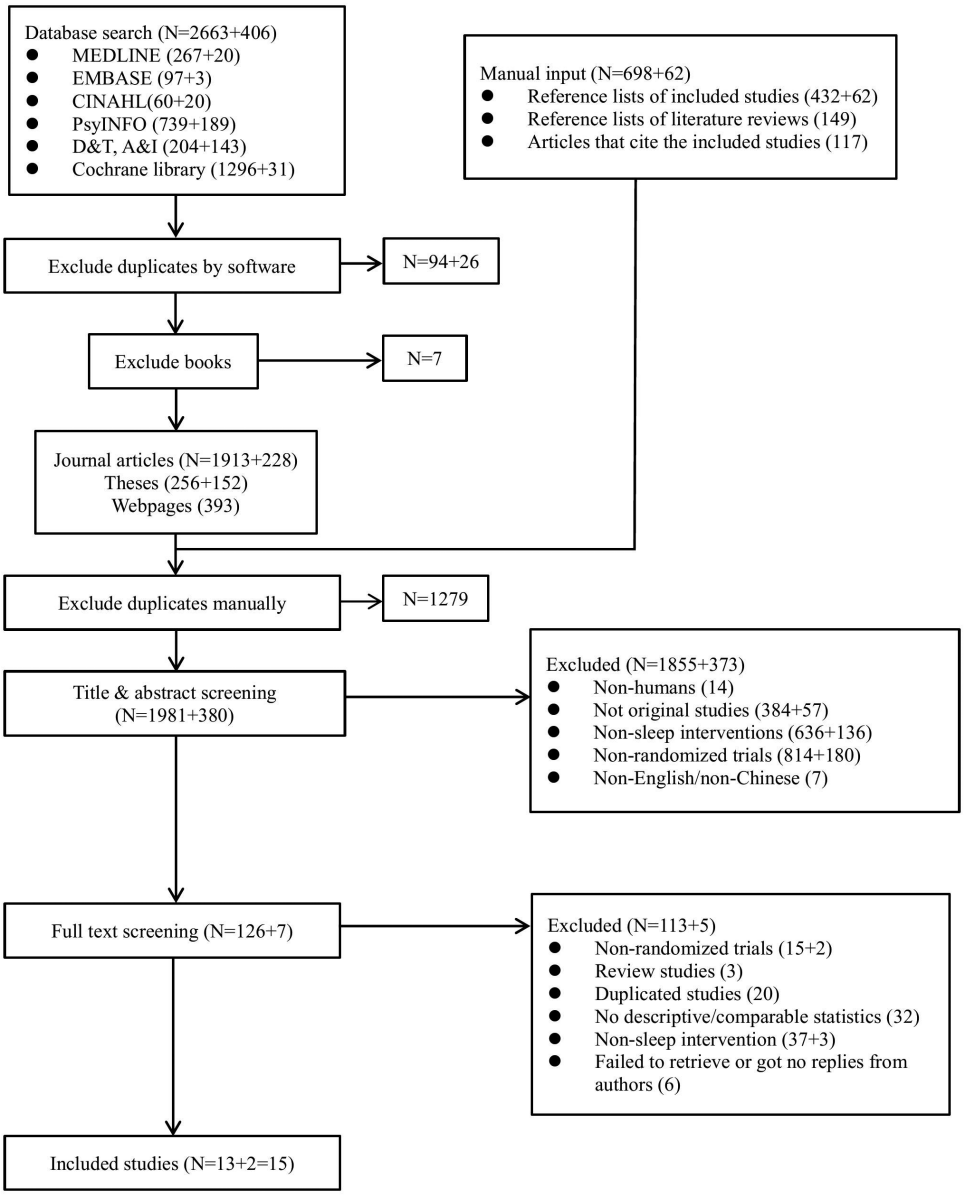


Figure 1. Selection of trials for inclusion in the review (+ indicates updated review).

Table 1. Characteristics of included studies of a systematic review and meta-analysis of sleep hygiene education as a treatment of insomnia (up to May 2017)

First author, year	Country/type of case	Source of participants	Mean age, year/% female	Diagnostic criteria	Study design	Baseline severity, mean score	Treatment duration	Follow-up	Sample size	Major outcomes	Results reported	Risks of bias[a]
Comorbid insomnia												
Edinger *et al.* (23)	USA/PI and CMI	Postal survey and physician referral	PI: 54.2/12.5% CMI: 54.2/14.6%	RDC and DSM-IV	Two-parallel arms (CBT-I; SHE)	PI: PSQI: CBT-I: 11.0/ SHE: 11.6 CMI: PSQI: CBT-I: 13.7/ SHE: 12.0	8 weeks	Immed and 6 months	81	PSQI, DBAS, Sd, actig	PI and CMI: CBT-I > SHE in Sd-SOL, WASO, TST and SE (immed) and Sd-WASO and TST (6 months)	U, U, L, L, L, L, L, L
Epstein *et al.* (24)	USA/breast cancer survivors with insomnia > 3 months	Mass media and support group	58.2/100%	Sd-SOL/ WASO ≥ 30 min for ≥ 3 nights/ weeks	Two-parallel arms (CBT-I; SHE)	Sd-SE: CBT-I: 69.0/ SHE: 72.2	6 weeks	2 weeks	72	Subj rating, Sd, actig	CBT-I > SHE in subj ratings on SOL, WASO, TST and quality of sleep.	L, U, H, L, L, L, L
Martínez *et al.* (25)	Spain/25–60 years with fibromyalgia	Specialized clinic	47.6/100%	DSM-IV	Two-parallel arms (CBT-I; SHE)	PSQI: CBT-I: 15.3/ SHE: 14.9	6 weeks	Immed, 3 and 6 months	59	PSQI	CBT-I > SHE in PSQI	L, U, H, L, L, L, L
Nakamura *et al.* (26)	USA/cancer survivors	Specialized clinic, mass media and support group	MBB: 55.4/68.4% MM: 50.8/80.0% SHE: 51.6/77.8%	MOS-SS ≥ 35	Three-parallel arms (MBB; MM; SHE)	MOS-SS: MBB: 58.0/ MM: 63.3/ SHE: 54.9	3 weeks	Immed and 2 months	57	MOS-SS	MBB and MM > SHE in MOS-SS	L, U, H, U, L, L, L
Insomnia disorder												
Alessi *et al.* (27)	USA/ >60 years with insomnia > 3 months	Postal	72.2/3.1%	ICSD	Two-parallel arms (CBT-I; SHE)	PSQI: CBT-I: 9.4/ SHE: 8.3	6 weeks	1 week, 6 months and 12 months	159	PSQI, ISI, Sd, actig	CBT-I > SHE in Sd-SOL, TWT and SE, PSQI and ISI.	L, L, L, L, L, L, L, L
Bjorvatn *et al.* (28)	Norway/insomnia > 6 months	Mass media and website	50.0/58%	BIS	Two-parallel arms (CBT-I; SHE)	PSQI: CBT-I: 12.9/ SHE: 12.8	3 months	3 months	155	BIS, PSQI	CBT-I > SHE in BIS, PSQI and DBAS	U, U, H, U, L, L, L
Black *et al.* (29)	USA/ >55 years with insomnia	Mass media and community	66.3/67%	PSQI >5	Two-parallel arms (MAP; SHE)	PSQI: MAP: 10.2/ SHE: 10.2	6 weeks	10 weeks	49	PSQI, AIS	MAP > SHE in PSQI and AIS	L, L, H, U, L, L, L

Table 1. *Continued*

First author, year	Country/type of case	Source of participants	Mean age, year/% female	Diagnostic criteria	Study design	Baseline severity, mean score	Treatment duration	Follow-up	Sample size	Major outcomes	Results reported	Risks of bias[a]
Dawson *et al.* (30)	USA/adults with insomnia	NR	53.6/68%	NR	Two-parallel arms (CBT-I; SHE)	ISI: CBT-I: 17.0/SHE: 19.0	4 weeks	Immed and 3 months	87	ISI	CBT-I > SHE in ISI	U, U, U, U, U, U, U, U
Falloon *et al.* (31)	New Zealand/16–75 years with insomnia > 6months	Primary care	53.5/77.3%	Insomnia > 3 nights/weeks	Two-parallel arms (SSR+SHE; SHE)	PSQI: SSR 10.4/SHE: 10.3	2 weeks	3 and 6 months	97	PSQI, ISI, Sd, actig	SSR+SHE > SH in PSQI, ISI and act-SE	L, L, L, H, L, L, L
Gellis *et al.* (32)	USA/psychology undergraduates	University	NR/64.7%	ISI ≥ 8 and WASO/SOL > 30 min ≥ 3 nights/weeks >1 months	Two-parallel arms (CRT+SHE; SHE)	ISI: CRT+SHE: 15.3/SHE: 16.8	NR	1 months	51	ISI	CRT+SHE > SHE in ISI	L, U, H, U, L, L, L
McCrae *et al.* (33)	USA/ ≥ 65 years	Physician referral and advertisement	77.2/65%	ICSD, DSM-IV, and SOL/WASO ≥ 31 min ≥ 3 nights/weeks > 6 months	Two-parallel arms (MBT; SHE)	Sd-SE: MBT: 72.5/SHE: 76.8	2 weeks	2 weeks	20	Sd	MBT > SHE in Sd-SOL and SE	U, U, H, U, L, L, L
Nishinoue *et al.* (34)	Japan/Dayshift office workers	IT company	31.3/14.2%	PSQI ≥ 6 in 62.2% of subjects	Two-parallel arms (MBT+SHE; SHE)	PSQI: MBT+SHE:6.9/ SHE: 6.3	1 week	3 months	127	PSQI	MBT + SHE > SHE in PSQI	U, U, H, U, L, L, L
Sun *et al.* (35)	China/ ≥ 65 years	Community	69.7/74.7%	PSQI >5	Two-parallel arms (Rel+SHE; SHE)	PSQI: Rel+SHE: 9.6/ SHE: 9.5	4 weeks	3, 6 and 12 months	75	PSQI, ESS	Rel+SHE > SHE in PSQI and ESS	L, U, H, U, L, L, L
Waters *et al.* (36)	USA/18–59 years	Mass media	45.6/79.3%	SOL/WASO > 30 min ≥ 4 nights/weeks > 1 month	Two-parallel arms (CBT-I; SHE)	NR	2 weeks	Immed	26	PSG, Sd	CBT-I > SHE in Sd-SOL and WASO	U, U, H, U, L, L, L
Wang *et al.* (37)	China/18–65 years	Psychology clinic	41.2/54.4%	Insomnia and hypnotics use > 1 month	Two-parallel arms (CBT-I; SHE)	PSQI: CBT-I 10.4/ SHE: 10.1	4 weeks	4 weeks	79	PSQI, ISI	CBT-I > SHE in PSQI and ISI	L, L, H, L, L, L, L

>, is significantly more effective than; actig, actigraphy; AIS, Athens insomnia scale; BIS, Bergen insomnia scale; CBT-I, cognitive behavioural therapy for insomnia; CMI, comorbid insomnia and psychiatric disorders; CRT, cognitive refocusing treatment; DSM, diagnostic and statistical manual of mental disorders; H, high; ICSD, international classification of sleep disorders; immed, immediate; ISI, insomnia severity index; L, unclear; MAP, mindful awareness practice; MBB, mind body bridging program; MBT, multicomponent behavioural treatment; MM, mindfulness meditation; MOS-SS, medical outcome study sleep scale; NR, not reported; Rel, relaxation training; PI, primary insomnia; PSG, polysomnography; PSQI, Pittsburgh sleep quality index; Sd, sleep diary; SE, sleep efficiency; SHE, sleep hygiene education; SOL, sleep onset latency; SSR, simplified sleep restriction; TST, total sleep time; U, unclear; WASO, wake after sleep onset.

[a]Risks of bias assessment using Cochrane's criteria in random sequence generation, allocation concealment, blinding of participant and personnel, blinding of outcome assessors, incomplete outcome data addressed, selective outcome reporting and other sources of bias.

complementary and alternative medicine therapy or no treatment. Subjects were recruited through multiple sources, and the criteria used for diagnosis of insomnia varied between studies. There were also great differences in subject characteristics. Four studies included only older adults, while two studies were on cancer survivors, one on university students and one on patients with fibromyalgia. The most common outcome measure was Pittsburgh Sleep Quality Index (PSQI), which is a 19-item self-rated questionnaire for evaluating subjective sleep quality over the past month (38). The PSQI score ranges from 0 to 21 with a score of 5 or above being suggestive of poor sleep and an improvement of three points or more has been used to define treatment response (39). The other commonly used outcome measures are sleep diary variables. Sleep efficiency (SE) is a summary index of sleep diary variables; a SE <85% represents poor sleep and an improvement ≥10% is suggestive of treatment response (39). Both PSQI and sleep diaries are well-established assessments of sleep and insomnia (40). Objective measures are rarely used. Only three studies used actigraphy and one study used polysomnography. Baseline insomnia severity was mild to moderate, as indicated by a mean PSQI score ranging from 6 to 15 across studies. Eight of the 15 studies had only one follow-up, which was arranged at immediate post-treatment or up to 3-month post-treatment.

Description of SHE

The number of sessions of SHE ranged from 1 to 6, with a median of three sessions (Table 2). Six studies used group approach, five studies used individualized approach, and four studies used printed material. General knowledge about sleep architecture, substance use, regular exercise and bedroom arrangement were commonly covered during SHE, followed by sleep-wake regularity and avoidance of daytime naps in seven programs, and stress management in five programs. Ten studies mentioned the use of a standardized manual, 10 studies provided therapist training, 8 studies had therapist supervision and 5 studies had treatment fidelity monitoring.

Assessment by the Cochrane's risk of bias assessment

Results are shown in Table 1. Blinding of participants and personnel was most difficult, with 11 of the 15 studies having a high risk of bias. Allocation concealment was also unclear in 11 of the 15 studies, while blinding of outcome assessors was unclear in 9 of the 15 studies. The risk of bias due to incomplete or selective outcome reporting and other sources of bias were low in all studies, except the study by Dawson *et al.* (30).

Efficacy assessment

Within-group difference

Table 3 presents the within-group meta-analyses on subjective and objective measures. Forest plots on sleep-diary-derived SE and PSQI are shown in Figure 2a and b. Supplementary Figures S1–S17 present the forest plots of other variables. Other than PSQI and Insomnia Severity Index (ISI), there was no significant heterogeneity between studies. There were significant pre- to post-treatment improvements in sleep-diary-derived sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST) and SE, PSQI and ISI. The within-group effect size was small for sleep diary variables (0.23–0.35) and medium for PSQI and ISI (0.51–0.67). In their native units, SOL was improved by 5 min, WASO by 12 min, TST by 25 min, SE by 5%, PSQI by two points and ISI by three points. The pre- to post-treatment difference in actigraphy variables was not significant. The leave-one-out sensitivity analysis found that the significant finding in PSQI and ISI was still present when an outlying study was removed. Funnel plot was not performed due to the small number of studies.

Between-group difference

Pooled analyses showed that CBT-I was significantly more effective than SHE in terms of SOL, WASO, SE, PSQI and ISI, but no significant difference in actigraphy measures (Table 3). There was moderate heterogeneity between studies in PSQI, but the significant finding was still present when outlying studies were removed. The between-group effect size was medium for SOL, WASO and SE (0.48–0.67) and medium to large for PSQI and ISI (0.67–0.92). CBT-I was more effective than SHE for improving SOL by 11 min, WASO by 14 min, SE by 8%, PSQI by two points and ISI by four points. Forest plots of SE and PSQI are presented in Figure 2c and d. Pooled analyses also found that mindfulness-based therapy produced greater improvement in PSQI than SHE, but only two studies were available for analysis (Hedges's $g = 1.13$, CI = 0.64, 1.62, $P < 0.001$).

Subgroup analyses

There were no significant differences in subgroup analysis of the impact of insomnia nature (primary versus comorbid), delivery modality (in-person versus printed material) and the number of SHE sessions (1–2 versus ≥ 3) on PSQI and SE (Supplementary Table 2).

Discussion

Our study showed that SHE was associated with sleep improvements, based on significant pre- to post-treatment changes, but it was less effective than CBT-I and mindfulness-based therapy. Within-group improvements and between-group differences were shown only in subjective measures. Subgroup analyses could not detect any impact of comorbid insomnia, delivery modality and the number of sessions on outcomes. The overall finding seems to suggest that CBT-I is more effective than SHE for the treatment of insomnia. However, there are uncertainties in the finding due to methodological problems in studies comparing SHE and CBT-I and practical and cost-effectiveness issues regarding the implementation of CBT-I. A recommendation to abandon using SHE in primary care cannot be made with certainty.

A systematic review found that psychological placebo in the form of sham procedure had small pre- to post-treatment effect sizes on sleep diary measures (0.12 to 0.36) and a moderate effect size on subjective sleep quality (0.52) (41). Our study showed that the pre- to post-treatment effect sizes of SHE were quite similar to psychological placebo. If treatment response was defined as an improvement in PSQI by 3 points or SE by 10% (39), the pre- to post-treatment improvement following SHE was not up to the level.

Compared to CBT-I, SHE was shown to be significantly less efficacious. The difference in effect size was medium to large, depending on the outcome measures. In terms of native units, CBT-I outperformed SHE in SE by 8% and PSQI by two points. Although most of the included studies used standardized manuals and had therapist training and supervision, only five studies had treatment fidelity monitoring. It remains unclear whether the efficacy of SHE can be enhanced by treatment fidelity monitoring and a more comprehensive coverage of sleep hygiene recommendations.

If SHE was introduced as an entry-step treatment for insomnia in primary care, a standardized and comprehensive SHE package should be developed, instead of information leaflets alone. Due to

Table 2. Summary of sleep hygiene education program of a systematic review and meta-analysis of sleep hygiene education as a treatment of insomnia (up to May 2017)

First author, year	No. of sessions	Group (Gp)/ individual (Ind)	Therapist	Duration of sessions (min)	Avoid caffeine	Avoid nicotine	Avoid alcohol	Regular exercise	Manage stress	Reduce bedroom noise	Sleep time regularity	Avoid daytime naps	General sleep knowledge
Comorbid insomnia													
Edinger *et al.* (23)	4	Ind	Clinical psychologist	30–60	√	NR	√	√	NR	√	NR	NR	√
Epstein *et al.* (24)	4	Gp	Psychiatric nurse	60–120	√	√	√	√	√	√	√	√	√
Martinez *et al.* (25)	6	Gp	Clinical psychologist	90	√	√	√	√	NR	√	√	√	√
Nakamura *et al.* (26)	3	Gp	Social worker	90	√	√	√	√	√	√	√	√	NR
Insomnia disorder													
Alessi *et al.* (27)	5	Gp	Master's degree non-clinician	60	NR	NR	NR	√	NR	√	√	√	√
Bjorvatn *et al.* (28)	1	Printed material	NA	NA	√	√	√	√	NR	√	NR	NR	√
Black *et al.* (29)	6	Gp	Master in public health	120	√	√	√	√	√	√	√	√	√
Dawson *et al.* (30)	4	Printed material	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR
Falloon *et al.* (31)	2	Ind	General practitioner	NR	√	NR	NR	NR	√	NR	NR	NR	NR
Gellis *et al.* (32)	1	Ind	Clinical psychologist	15	√	√	√	√	NR	√	NR	√	NR
McCrae *et al.* (33)	2	Ind	Counsellor and social worker	50	√	√	√	√	NR	NR	NR	NR	√
Nishinoue *et al.* (34)	1	Gp	Physician	40	√	√	√	√	√	√	√	√	√
Sun *et al.* (35)	1	Printed material	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR
Waters *et al.* (36)	2	Printed material	NA	NA	√	√	√	√	NR	√	√	√	NR
Wang *et al.* (37)	4	Ind	Clinical psychologist	15–60	√	NR	√	√	NR	√	NR	NR	NR

NA, not applicable; NR, not reported.

Table 3. Summary of within-group and between-group meta-analyses of a systematic review and meta-analysis of sleep hygiene education as a treatment of insomnia (up to May 2017)

	No. of datasets	Mean difference[a]	CI	*Q*	I^2	Hedges's	Mean difference[a]	CI	*Q*	I^2	Hedges's *g*	Quality of the evidence (GRADE)
		Within-group meta-analyses					Between-group meta-analyses: SHE versus CBT-I					
Sleep diary and questionnaires												
Sleep onset latency, min	8	5.41**	1.78, 9.03	8.06	13%	0.23**	11.44***	5.55, 17.34	8.67	19%	0.66**	Moderate[b]
Wake after sleep onset, min	8	12.16***	6.07, 18.25	5.91	0%	0.32***	14.01***	6.13, 21.89	2.90	0%	0.48***	Moderate[b]
Total sleep time, min	5	25.06***	11.86, 38.26	3.21	0%	0.28*	9.14	−10.18, 28.46	0.07	0%	0.13	Low[b,c]
Sleep efficiency, %	6	4.72***	2.66, 6.78	1.16	0%	0.35***	7.66***	4.68, 10.64	5.29	5%	0.67***	Moderate[b]
Pittsburgh sleep quality index score	9	1.75***	1.05, 2.45	22.76	65%	0.51***	2.26***	1.46, 3.05	14.58	45%	0.67***	Low[b,d]
Insomnia severity index score	5	3.00**	0.88, 5.13	23.92	83%	0.67**	3.55***	2.69, 4.40	3.04	0%	0.92***	Moderate[b]
Actigraphy												
Sleep onset latency, min	3	1.30	−2.38, 4.99	0.23	0%	0.09	3.49	−1.72, 8.71	0.22	0%	0.24	Low[b,c]
Wake after sleep onset, min	3	0.41	−5.33, 6.15	0.08	0%	0.03	3.88	−3.71, 11.47	1.30	0%	0.22	Low[b,c]
Total sleep time, min	3	3.97	−8.30, 16.25	0.31	0%	0.10	5.40	−11.72, 22.52	0.01	0%	0.10	Low[b,c]
Sleep efficiency, %	4	0.40	−0.89, 1.70	0.06	0%	0.06	1.49	−0.23, 3.22	0.70	0%	0.22	Low[b,c]

CBT-I, cognitive-behavioural therapy for insomnia; GRADE, Grading of Recommendations Assessment, Development, and Evaluation; SHE, sleep hygiene education. GRADE Working Group grades of evidence High quality: We are very confident that the true effect lies close to that of the estimate of the effect. Moderate quality: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. Low quality: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect. Very low quality: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

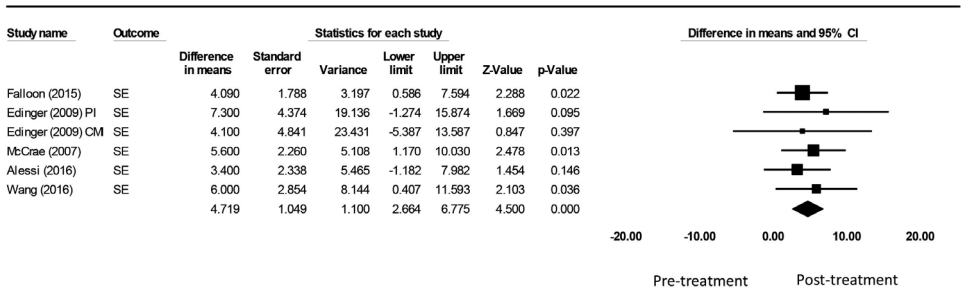
[a]Positive values indicate pre-post improvements and greater effectiveness of CBT-I.

[b]Methods of sequence generation/allocation concealment were unclear, and blinding of participants was not achieved in most of the studies (downgraded by 1 due to limitation of study).

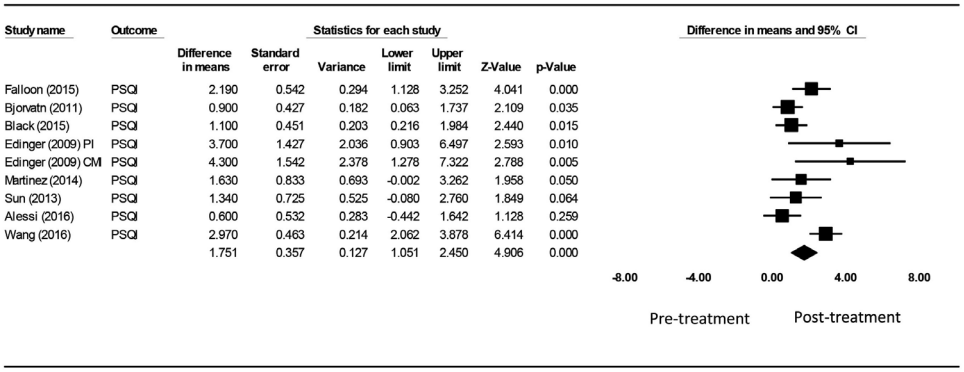
[c]The confidence intervals did not exclude no difference so it is difficult to tell whether effects CBT_I and SHE was different (downgraded by 1 due to imprecision).

[d]There was important variation between the study results (I^2 = 45%, P = 0.07) (downgraded by 1 due to imprecision due to inconsistency).

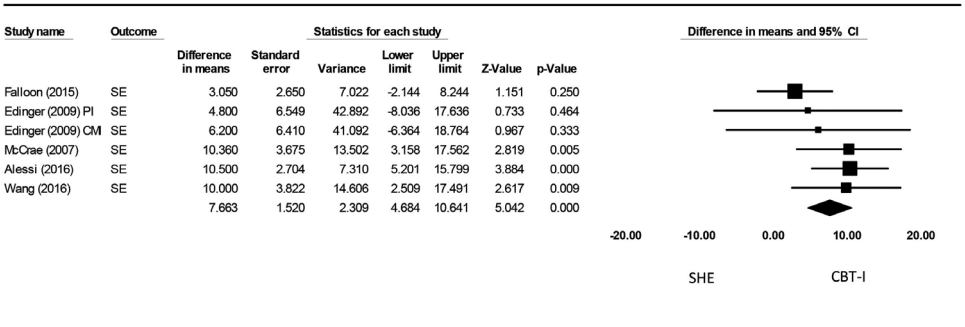
*P <0.05, **P < 0.01, ***P < 0.001.



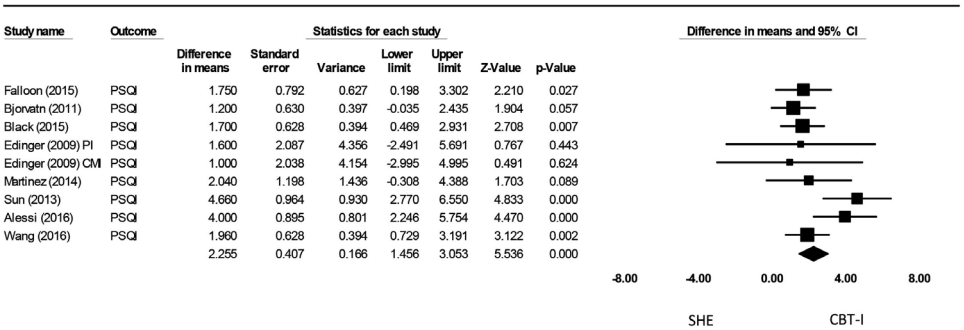
(a)



(b)



(c)



(d)

Figure 2. (a) Within-group comparison on sleep-diary-derived sleep efficiency (SE), in %; (b) Within-group comparison on Pittsburgh Sleep Quality Index (PSQI), in total score; (c) Comparison of sleep hygiene education (SHE) versus cognitive-behavioural therapy for insomnia (CBT-I) on sleep-diary-derived sleep efficiency (SE), in %; (d) Comparison of sleep hygiene education (SHE) versus cognitive-behavioural therapy for insomnia (CBT-I) on Pittsburgh Sleep Quality Index (PSQI), in total score.

differences in therapists' expertise and training requirement, studies should compare the implementation, acceptability and cost-effectiveness issues between SHE and CBT-I. A qualitative study suggested that although general practitioners know CBT-I, they seldom refer patients for treatment (42). More work is needed to educate general practitioners on the health risks of insomnia and the availability of psycho-behavioural treatments. As SHE may be able to resolve the patient's problem and has little or no risk of adverse effects; in places where CBT-I is unavailable or too costly, SHE may be considered as a first-step treatment.

Cross-sectional studies have revealed that daytime napping, smoking, alcohol use and uncomfortable sleeping environment are more common in individuals with insomnia, compared to good sleepers; however, the frequencies of these behaviours are not high (43). The findings may explain why SHE may not be a sufficient treatment, while having poor sleep hygiene may be a prerequisite for using SHE.

Despite an extensive literature search, the major limitation of our review was the small number of included studies. We did not know whether there were missing papers that used non-standard spelling or non-standard terms to define the intervention. Future studies should search using a combination of Medical Subject Heading (MeSH) and free-text terms. Suggestions on using filters and highly sensitive strategies for identifying randomized trials are available in the Cochrane Handbook for Systematic Reviews of Interventions (44). Participants' characteristics, recruitment source and baseline severity varied widely across studies; hence generalization to a specific setting and patient group was not possible. Methodological quality of the included studies was fair. Due to the nature of intervention, blinding of participants and personnel and allocation concealment were difficult in most studies; however, publication bias was unlikely because SHE was often used as a control intervention and the results were mostly consistent across studies.

In conclusion, SHE resulted in pre- to post-treatment improvements in sleep; however, it fared worse than CBT-I and mindfulness-based therapy for the treatment of insomnia. Although CBT-I was shown to be more effective than SHE, the difference in sleep-diary-derived SE was 8%; for PSQI, it was two points' difference. More studies are needed to examine whether SHE is better than CBT-I in terms of acceptability, adherence, understanding, cost-effectiveness and ease of implementation. To understand the effectiveness of SHE, future studies should ensure treatment fidelity and a comprehensive coverage of sleep hygiene recommendations. In addition, studies comparing SHE with placebo or no treatment are needed.

Supplementary material

Supplementary material is available at *Family Practice* online.

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