Res Medica 2014, Volume 22, Issue 1

RES MEDICA
Journal of the Royal Medical Society

REVIEW ARTICLE

Sleep Problems in Cancer: Effective Psychological Interventions

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Abstract

Introduction: Sleep problems are one of the most prevalent complications cancer patients experience. These have been shown to produce harmful effects such as reduced immunity and mood disturbances. While pharmacological agents for sleep problems may be used, psychological therapies should be considered where possible.

Aim: The aim of this review is to evaluate the effectiveness of different psychological interventions for sleep problems in cancer patients.

Methods: A systematic review was conducted. Databases searched included PsychINFO, Embase, MEDLINE, and Web of Science for papers published during the period from January 2003 to December 2013. Combinations of the following terms were used: "sleep disturbance", "sleep problems", "insomnia", "cognitive behavioural therapy", "CBT", "non-pharmacological", "sleep hygiene", "psychological intervention", "psychological treatment", and "cancer".

Results: 22 papers were selected for analysis. The main finding from this systematic review was that cognitive behavioural therapy (CBT) and mindfulness-based stress reduction (MBSR) is the most promising psychological intervention for the treatment of insomnia in cancer patients. Other psychological treatments such as sleep education and multimodal programmes also demonstrate good potential for use in oncology.

Conclusions: Further randomized controlled trials comparing the effectiveness of CBT and MBSR in different types of cancer are required to determine their relative benefits and costs.

ISSN: 2051-7580 (Online) ISBN: 0482-3206 (Print)
Res Medica is published by the Royal Medical Society, 5/5 Bristo Square, Edinburgh, EH8 9AL

Res Medica, 2014, 22(1): 15-36.
doi:10.2218/resmedica.v22i1.776

Sleep Problems in Cancer: Effective Psychological Interventions

Introduction

Sleep problems are one of the most frequent symptoms that cancer patients experience and can persist for several years after cancer treatment.[1,2] Studies have shown that 30–50% of cancer patients encounter sleep disturbance,[3] and the prevalence of insomnia has been demonstrated to be 2–3 times higher in this group compared to the general population.[4] Sleep problems include insomnia, sleep apnoea, narcolepsy, night terrors, and sleepwalking, but the most common amongst cancer patients is insomnia.[5] Insomnia is defined as difficulty falling asleep or not feeling refreshed upon waking due to not sleeping for long enough.[6] The *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* criteria for diagnosing insomnia includes: difficulty initiating or staying asleep for 1 month or more, including taking 30 minutes or more to get to sleep, or over 30 minutes to re-initiate sleep after awakening, for more than 3 nights per week; not feeling refreshed upon awakening; and affected daytime functioning.[7]

In cancer patients, insomnia is often a result of physical or psychological aspects of cancer or cancer treatment, such as anxiety, depression, stressful life events, surgery, chemotherapy, hospitalization, pain, and delirium.[3] Insomnia can have many harmful effects on patients. Consequences include fatigue, reduced daytime functioning, and mood disturbances. Sleep problems can also potentially increase mortality and reduce immunity.[3] Such effects are undesirable, considering that patients with cancer are at an increased risk of morbidity and mortality anyway. Effective interventions to tackle sleep disturbance may prove beneficial as an adjunctive treatment in cancer patients.

One of the current recommended modes of treatment for insomnia is pharmacological therapy; primarily hypnotics, such as zaleplon, zolpidem, and zopiclone.[8] However, pharmacological agents often do not treat the underlying cause of insomnia and are therefore only suitable as short-term treatment. Drugs come with side effects such as drowsiness, tolerance, and dependence.[9] One study suggests that cancer patients would prefer to adopt non-pharmacological therapies rather than take hypnotics.[10] Effective psychological interventions should be looked at increasingly to be used alongside hypnotics, and in some cases, replace their use.

The aim of this review is to investigate psychological interventions that can be used to treat sleep problems in adult cancer patients undergoing curative treatments, and explore their effectiveness.

Venables, H. Sleep problems in cancer: effective psychological interventions. *Res Medica* 2014, 22(1), pp. 15-36.
doi:10.2218/resmedica.v22i1.776

Methods

In December 2013, PsychINFO, Embase, MEDLINE, and Web of Science were searched. Search terms, and their combinations, are summarized in Table 2. Publications dated from "2003–current" was used to obtain the most up-to-date literature.

Exclusion criteria included patients on non-curative or palliative treatment; children and adolescents; qualitative studies; and non-primary research studies. In addition, the archives of the last 10 years of the *Psycho-oncology* journal were looked at to make sure that all relevant papers from this journal were found when carrying out the database search. The number of results from the database searches are in Table 1.

Table 1. Search results

Database	Number of results
Embase	86
PsychINFO	26
MEDLINE	53
Web of Science	18
ımber of results	182

Table 2. Database search

Line	Search term	Line	Search term
1	"sleep disturbance"	8	"cognitive behavioral therapy"
2	"sleep problems"	9	"CBT"
3	"insomnia"	10	"non pharmacological"
4	1 or 2 or 3	11	"sleep hygiene"
5	"psychological intervention*"	12	5 or 6 or 7 or 8 or 9 or 10 or 11
6	"psychological treatment*"	13	"cancer"
7	"cognitive behavioural therapy"	14	4 and 12 and 13

Following the database search, 164 of the 182 papers identified were excluded using the exclusion criteria. 18 studies were identified for this review using the primary search.[4,11-27] 4 additional papers were identified from references cited from the 18 studies.[28-31] Searching the *Psycho-oncology* journal found no further studies. A total of 22 studies were identified for analysis.[4,11-31]

Results

The studies included in this review were mainly randomized controlled trials (RCTs),[4,11,12,15-16,17,19-24,,27,28,30,31] but also included pilot studies,[13,26] quasi-experiments,[14,18,29] and retrospective studies.[25] In addition, 8 papers were published as abstracts only[11,12,14,15,22,23,25,26] as they were presented in conferences and subsequently published in journal supplements.

The 2 main treatments used by the identified studies were cognitive behavioural therapy (CBT) and mindfulness-based stress reduction (MBSR). The other papers focused on other forms of psychological interventions.[19,25,27] (See Table 9 in the Appendix for the main characteristics of the studies.)

The Insomnia Severity Index (ISI)[32] was the measurement of insomnia used in most of the studies. ISI is a self-rating questionnaire, and a score of 8.0 or more is diagnostic of insomnia. Another scale that was used in

many of the papers was the Pittsburgh Sleep Quality Index (PSQI),[33] which is also a self-rating questionnaire. A score of more than 5.0 indicates poor sleep.

Other tools that were used to monitor sleep were daily sleep diaries and sleep actigraphy. Sleep diaries are self-reported diaries used to record the time points at which a participant goes to sleep and wakes up during the night. Sleep actigraphy involves a device worn around the wrist or ankle that records movement during sleep.[34] These tools measure sleep parameters including total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE), time in bed (TIB), and number of awakenings.

All studies were read, pertinent data were extracted, and entered into tables. To compare the results in each of the studies, percentage improvement was used for some of the variables, especially ISI[32] and PSQI[33] scores.

CBT

The main psychological intervention studied was CBT. CBT for insomnia (CBT-I) usually includes sleep restriction, cognitive therapy, stimulus control, and relaxation therapy.[35] During sleep restriction, the patient is allowed a few hours of sleep before they are woken. The time for sleep is progressively increased, until the patient reaches a more normal amount of sleep. Cognitive therapy is utilized to block negative thoughts and reduce anxiety about not falling asleep. Stimulus control diminishes negative associations between sleep and the sleep environment and lessens the amount of time spent awake in bed. Relaxation therapy is designed to reduce anxiety and body tension to help the patient sleep.[35]

15 papers focused on CBT-I.[4,12-18,20-23,26,30,31] Different techniques of CBT-I were tested in different studies, including self-help CBT, professionally-administered CBT, individual CBT and group CBT.

Self-help CBT

4 studies[4,12,13,15] trialled self-help CBT, which was conducted by the patient without any professional help. 2 of these studies[12,13] used video-based CBT to treat insomnia; this entailed a cartoon video followed by 6 booklets. 1 study by Savard J *et al.*[12] compared video-based CBT with professionally administered CBT. Results showed that there was no significant difference between the 2 groups for any of the variables; however, the professionally adminsitered CBT had a greater improved TST. This group also had a greater mean reduction in ISI score[32] of 58.2%, compared with the video-based group with a reduction of 44.5%.

Another study by Ritterband LM *et al.*[4] tested an online CBT-I intervention called Sleep Healthy Using The Internet (SHUTi), which showed an average reduction in ISI score[32] of 52.0%. The last self-help study by Casault L *et al.*[15] used bibliotherapy as the technique for insomnia, involving 6 booklets plus 3 phone calls with trained health professionals. Results showed that the self-help group's sleep problems improved significantly compared with the control group, who received no treatment (p = 0.001). The paper by Casault L *et al.*[15] showed bibliotherapy to be an effective CBT method, reporting an average reduction in ISI score[32] of 56.2%. In contrast, the video-based CBT trials had the least effect on insomnia with average reductions of 45.2%[13] and 44.5%.[12] Table 3 shows the results of each of the self-help CBT studies.

Table 3. Self-help CBT results

Self-help CBT study	Mean start ISI score[32] in self-help group	Mean end ISI score[32] in self-help group	Mean reduction in ISI score[32] (%) in self-help group	Mean reduction in ISI score[32] (%) in control group
Video-based Savard J *et al.*[13]	15.7	8.6	45.2	No control
Video-based Savard J *et al.*[12]	14.6	8.1	44.5	Unknown
Online-based Ritterband LM *et al.*[4]	17.1	8.2	52.0	9.4
Bibliotherapy Casault L *et al.*[15]	12.1	5.3	56.2	6.6

Professionally administered CBT

12 studies[12,14,16-18,20-23,26,30,31] focused on professionally administered CBT. Each CBT-I intervention was delivered by a health professional trained to give the treatment, and all of the studies showed improvement in sleep problems post-intervention. 5 of the professionally administered studies[12,17,18,20,21] used ISI scores[32] as a measurement. All of the professionally administered CBT studies that used this method found a reduction in the scores; Quesnel C *et al.*[18] found an average reduction of 63.9%. The scores are shown in Table 4.

Table 4. Professionally administered CBT ISI

Professionally administered CBT study	Mean start PSQI score[33]	Mean end PSQI score[33]	Mean reduction in scores (%)
Berger AM *et al.*[31]	7.2	6.6	7.3
Fiorentino L[20]	12.1	7.6	37.6

Studies using PSQI scores[33] as an outcome measure reported a reduction in these measures also. These are shown in the table below. However, neither of the scores decreased to below 5.0, above which is a diagnostic score for insomnia.

The professionally administered CBT studies that used actigraphy[16,20,23,30,31] and daily sleep diaries[16-18,20,23,26,30,31] also demonstrated improved results. All of the studies that used these tools found a reduction in SOL (except Fiorentino L[20])

and WASO. A RCT by Espie CA *et al.*[16] found that the mean time spent awake per night (SOL+WASO) reduced by 55 minutes on average, compared with no change in the control group who received treatment as usual.

Table 5. Professionally administered CBT PSQI

Professionally-administered CBT study	Mean start ISI score[32] in professionally administered group	Mean end ISI score[32] in professionally administered group	Mean reduction in ISI score[32] (%) in professionally administered group	Mean reduction in ISI score[32] (%) in control group
Savard J *et al.*[12]	14.1	5.9	58.2	Unknown
Savard J *et al.*[17]	16.2	7.6	53.1	15.0
Quesnel C *et al.*[18]	16.9	6.1	63.9	No control
Fiorentino L[20]	16.8	12.2	27.4	4.0
Dirksen SR *et al.*[21]	23.9	14.4	39.9	28.2

All of the studies also found an improvement in SE, including the study by Espie CA *et al.*[16] which found an average increase in SE by 10%, compared with 0% in the control group.

Most of the studies reported increased TST in the interventional group.[16,26,30,31] However, the RCTs by Fiorentino L,[20] Savard J *et al.* in 2013,[12] and Savard J *et al.* in 2005[17] found no significant increase in TST in the interventional or control groups ($p = 0.033$ [20] and $p < 0.5$ [17] respectively).

Table 10 in the appendix compares professionally administered with self-help CBT.

Group versus individual CBT

4 of the professionally administered CBT studies gave participants individual sessions.[12,20,26,31] The rest all delivered CBT in group sessions.[14,16-18,21-23,30] The outcomes of the studies using ISI scores[32] are shown in the table below. Group sessions had the largest average decrease with 63.9% in the study by Quesnel C *et al.*[18] However, the study by Savard J *et al.*,[12] which used individual sessions, was close behind with an average decrease of 58.2%. The individually delivered CBT studies[12,20,26,31] all showed improvements in WASO and SE.

Table 6. Group versus individual CBT results

Study	Average ISI score[32] decrease (%)	Mean end ISI score[32]
Individual		
Savard J *et al.*[12]	58.2	5.9
Fiorentino L[20]	27.4	12.2
Group		
Savard J *et al.*[17]	53.1	7.6
Dirksen SR *et al.*[21]	39.9	14.4
Quesnel C *et al.*[18]	63.9	6.1

Studies by Berger AM *et al.*[31] and Matthews E *et al.*[26] demonstrated increases in TST, whereas other studies[12,20] showed no significant change in TST ($p = 0.033$ [20]).

3 studies showed improved SOL[12,26,31], but one[20] showed no significant reduction. The group CBT studies obtained improvements in all sleep parameters, except one study by Savard J *et al.*[17] showed no significant progress in TST ($p < 0.5$). These results demonstrate that group delivered CBT

sessions may be slightly more effective than individual sessions.

CBT and other symptoms

Many of the CBT studies also showed a reduction in anxiety and depression[4,13,15,17,18,21] in patients who were treated with CBT-I, and an increase in quality of life.[4,13,15-17,21,23] The paper by Fiorentino L[20] found that although these results were not significant like other studies, there was a trend towards significance ($p = 0.03$).

MBSR

MBSR is a technique whereby patients are taught to practise mindfulness meditation to reduce stress and improve health.[36] Patients learn to stop and "be". The intervention tries to help them develop improved awareness of experiences in the present moment. Participants are taught to accept certain situations, see things precisely as they are, and then "let go" of situations by passively observing them and not doing anything to suppress or elevate them.[37]

4 RCTs[11,24,28,29] have trialled MBSR. 2 studies[11,29] showed improvements in SE. On the contrary, the study by Shapiro SL *et al.*[28] demonstrated no significant improvement in SE. This study also found no significant differences between the control and interventional groups; sleep quality improved in equal amounts in the 2 groups. The interventional group received MBSR sessions, whereas the control group received no formal instruction but could "freely choose" which stress management interventions to take part in. The feeling of being refreshed upon waking reduced over the study period, but the authors found that the more time spent practising mindfulness, the more improvement on sleep.

Additionally, the paper by Carlson LE *et al.*[29] used PSQI scores[33] as the main measure of insomnia. Pre-intervention, 91% of patients scored over 5, and 51% over 10. Post-intervention, 79% of patients scored over 5, and 27% over 10. Sleep quality, sleep disturbance, and sleep duration all improved significantly, with p values all below 0.001.

Similarly, the paper by Nakamura Y *et al.*[24] found improvements in sleep duration and sleep disturbance, using the Medical Outcomes Study Sleep Scale (MOS-SS). This trial compared 2 types of MBSRL: mind–body bridging (MBB) and mindfulness meditation (MM), with sleep hygiene education (SHE) as the control. MBB and MM are 2 different formats of MBSR; MM includes meditation whereas MBB focuses on "experiential bridging skills" and "mind–body mapping" to identify patients' "requirements" of situations[24]. The mean improvement for sleep disturbance and sleep duration are in the table below.

Table 7. Results for Nakamura Y *et al.*

MOS-SS subscale	MBB	MM	SHE
Unadjusted mean overall MOS-SS Scores			
Pre-intervention	57.08	61.42	54.57
Post-intervention	32.13	43.64	47.22
Follow-up	31.59	36.01	40.81
Mean sleep disturbance			
Pre-intervention	64.47	69.25	59.44
Post-intervention	32.57	46.69	46.84
Follow-up	31.79	37.50	39.13
Mean sleep duration (hours)			
Pre-intervention	6.13	6.45	6.33
Post-intervention	6.97	7.00	6.41
Follow-up	6.79	7.09	6.92

This study found that all 3 interventions improved sleep problems in cancer patients, but MM and MBB showed the most promising results. MBB was particularly useful in treating secondary symptoms such as depression, and also had the best overall mean follow-up MOS-SS score of 31.59, compared with 36.01 in MM and 40.81 in SHE.

Other Interventions

Other psychological interventions included self-hypnosis[19], sleep hygiene[21,24], a focused interdisciplinary intervention,[25] and a multimodal psychological sleep management programme.[27]

Sleep hygiene education was used as a control group compared with CBT and MBSR.[21,24,30] Sleep hygiene involves recommendations to improve sleep, and sleep education is designed to correct dysfunctional sleep-related beliefs.[30] The studies showed that although sleep hygiene did improve sleep problems, it did not improve sleep problems as much as other interventions did. The ISI score[32] in the study by Dirksen SR *et al.*[21] reduced by 28.2% in the sleep hygiene group, compared with 39.9% in the CBT group. Sleep hygiene was effective compared with MBSR,[24] but was not as effective long term. It also improved SOL, WASO, TST, TIB, and SE, but CBT had a better outcome on TIB, and patients reported a better sleep quality in this group.[30]

The paper on self-hypnosis by Farrell-Carnahan L *et al.*[19] obtained non–statistically significant improvements in insomnia. The intervention was accessed online, where patients listened to self-hypnosis recordings. The average ISI score[32] reduced by 28.1%.

The other papers showed more promising results.[25,27] The interdisciplinary intervention encompassed teaching and written information on sleep hygiene,[25] and found significant improvement in PSQI scores[33] ($p = 0.0007$) The multimodal programme[27] was mainly focused on relaxation techniques; participants were allocated to a progressive muscle relaxation (PMR) group, autogenic training (AT) group, or control group. Results showed significant improvement in SOL, sleep duration, SE, and sleep quality in the PMR and AT groups ($p < 0.001$ for all variables). No significant differences were found between them, although AT showed

a trend towards greater effectiveness, and both interventional groups improved compared with the control group. Sleep latency decreased by an average of 40.2 minutes in PMR (a mean decrease of 56.1%) compared with 30.7 in AT (a mean decrease of 51.9%.) On the other hand, sleep duration increased by an average of 73.7 minutes in PMR (a mean increase of 24.7%), and 93.0 minutes in AT (a mean increase of 30.7%). In addition, PMR had an average increase of 14.7% in SE, compared with an increase of 17.9% in the AT group. Average results for this trial are in Table 8.

Table 8. Results for sleep parameters, Simeit R *et al*.

Mean sleep scores	PMR	AT	Control group
Sleep efficiency (SE) (%)			
Pre-intervention	57.9	60.9	61.5
Post-intervention	72.6	78.7	68.5
Difference	+14.7	+17.9	+7.0
Percentage change (%)	25.3	29.4	11.4
Sleep onset latency (SOL) (mins)			
Pre-intervention	71.7	59.2	57.3
Post-intervention	31.5	28.5	46.5
Difference	−40.2	−30.7	−10.8
Percentage change (%)	56.1	51.9	18.8
Sleep duration (mins)			
Pre-intervention	298.9	303.0	319.4
Post-intervention	372.6	396.0	354.3
Difference	+73.7	+93.0	+34.9
Percentage change (%)	24.7	39.7	10.9

Critical appraisal

One limitation of the papers was inadequate sample sizes. 5[4,13,18,20,26] studies had a sample size under 30, which makes the results less likely to be able to be applied to the general population. Only 6 had sample sizes over 100.[12,16,22,23,27,31]

6 of the studies are not RCTs, which makes the results less reliable. 2[13,26] are pilot studies, 3[14,18,29] are quasi-experiments and 1[25] is a retrospective study. Also, some of the studies could only be accessed as abstracts.[11,12,14,15,22,23,25,26] This limits this review as not all of the data were published in these abstracts.

Moreover, the majority of papers focused on breast cancer and female patients only.[11,13,17,18,20,21,26,28,30,31] Other types of cancer and males may not be well represented, and may give different results to those of women with breast cancer. Therefore, it may not be possible to reliably apply the results from these studies to all types of cancer or to male patients.

Furthermore, neither the patients nor the therapists could be blinded during the RCTs due to the nature of the interventions. This may mean that some of the studies are biased or skewed by the "placebo effect".

Another limitation is that there is a lack of a common definition of insomnia. Quite a few of the papers[4,17,18,20,21,23] used the *DSM-IV* criteria for insomnia,[7] but others did not have a clear diagnosis at all.[11,12,14,22,26,27,28,31] This lack of a universal diagnosis means that some of the patients in some studies may not have actually had a clinical diagnosis of insomnia had they been assigned to a scale such as the *DSM-IV* criteria,[7] and therefore may not have needed any treatment. A lack of a common scale in all of the studies also made it hard to compare the results of all of the interventions to evaluate the most effective.

Finally, some of the studies[13,14,18,26,29] did not have a control group. This affects the reliability of the studies because the effectiveness of the intervention cannot be contextualized by comparison with a control group.

Discussion

The aim of this review was to evaluate the effectiveness of psychological interventions for insomnia in oncology patients undergoing curative therapy. All of the studies found that the psychological interventions effectively improved sleep problems in cancer patients. However, results showed that CBT-I and MBSR may be more effective than other interventions. Sleep hygiene education was shown to be useful for short-term treatment of insomnia, but not as effective as MBSR or CBT in the long term.[21,24] Self-hypnosis did not produce any significant improvements, but only one study with a very small sample size was carried out, so further trials need to take place to test this intervention,[19] as further studies may disprove this theory. The multimodal programme seemed to be fairly successful, as the relaxation therapies improved SE, SOL, and sleep duration.[27] However, further trials should be carried out to test this hypothesis as only one was found to be published so far. These results show that the multimodal programme and SHE may be useful for treatment of insomnia; however the results could be due to chance as there were not many trials published on these interventions.

In addition, professionally administered CBT seems to be more effective than self-help CBT. Table 10 in the appendix shows that professional CBT generally has a higher average ISI score[32] decrease, and 3 of the post-treatment scores are below 8.0, [12,17,18] above which is the score for the diagnosis of insomnia. Only 1 of the post-treatment scores was below 8.0 in the self-help studies.[15] This may be because CBT sessions with professionals are more likely to be carried out in an effective way than if the patient is doing it by themselves. The professional would know more about CBT than the patient, and would know how to change it slightly to fit their needs. The

patient may not be completely motivated to carry out the intervention properly on their own, whereas a healthcare professional would keep them on track during their sessions.

However, as professionally administered CBT may not always be available, either due to lack of CBT-trained health professionals or patients being too busy to attend CBT sessions, self-help CBT seems to be an effective alternative. In particular, the bibliotherapy self-help CBT intervention seemed to be the most effective, as it had the highest average reduction in ISI scores,[32] and the average score decreased below the diagnostic score of 8.0 for insomnia by the end of the trial.[15] This may be due to the phone calls that patients had with professionals during this intervention: it may have encouraged them to carry on with the CBT, and also give them directions as to where they were going wrong. The other 3 self-help CBT treatments did not have any contact with professionals so this may have negatively affected their results.

The highest average ISI score[32] decrease in individual CBT was 58.2%,[12] compared with 63.9%[18] in group-delivered CBT although there is no statistically significant difference. However, most of the group interventions found significant improvements in all sleep parameters,[14,16,18,21-23,30] compared with the individual CBT studies that showed uniform improvements in only WASO and SOL.[12,20,26,31] This may suggest that group CBT is more effective than individual CBT. This difference may be because patients feel obliged to participate more in group CBT. Also, they may learn tips from other patients about how to cope with their sleep problems, and the more sociable environment may also be another positive factor. There may have been an empathetic rapport within the group that helped the patients to improve their sleep.

Moreover, CBT seemed to have other positive effects, such as decreased anxiety and depression and increased quality of life. This illustrates that sleep quality, anxiety, depression, and quality of life are all linked, and treating insomnia may improve other conditions that cancer patients commonly suffer from. However, it is unclear whether treating insomnia produced these positive effects or whether it was just the general use of CBT. The studies also did not state whether these parameters were targeted during the CBT sessions that the patients received, so they may well have been incorporated into their treatment.

MBSR appears effective in reducing sleep problems. However, one paper[28] obtained results that showed no significant improvement in SE, and there was a reduction in feeling refreshed on awakening during the study.

On the other hand, 2 studies[11,29] found that SE significantly increased, and another paper[24] found significant improvements in sleep duration and sleep disturbance. This indicates that MBSR could be an effective intervention to improve insomnia in oncology patients. MBSR was shown to be effective for the patients included in these trials.

However, although unlikely, it could be possible that each of the studies that found improvements in insomnia were due to the patients' sleep improving naturally over time. This is doubtful because most of the patients that were enrolled had suffered with sleep problems for a long period of time. In addition, the patients could have been very stressed at the start of the study because of their insomnia, but may have relaxed as time went on due to reassurance and a positive social rapport; this could also have contributed to reducing their sleep problems.

Several of the studies had patients that were lost to follow-up.[16-18,22,30,31] The reasons for this ranged from the patients not completing measurements or responding to the researchers, to patients withdrawing due to not liking the treatment or because of death or illness. Some of the patients also experienced scheduling problems. This may show that some of the interventions, especially CBT, are difficult to adhere to. 3 of these studies[16,17,31] used intention-to-treat analysis, which would have reduced bias caused by patients dropping out. However, other studies[18,21,30] did not include the patients in their results after they had dropped out; this could have potentially produced bias and caused the results of these papers to be less reliable.

Moreover, the sample characteristics could have caused selection bias on the results. The majority of papers focused on breast cancer and women only.[11,13,17,18,20,21,26,28,30,31] The other papers that did not focus on breast cancer all had a higher numbers of female patients than male, and breast cancer represented the majority of cancer types in all the papers. Other types of cancer and males may be under-represented, and the same interventions may potentially produce different results to those seen in women with breast cancer. In addition, all of the papers' participants had a mean age of over 50. Age could be a confounding factor; therefore applying the results to oncology patients under the age of 50 may not be a reliable predictor of effectiveness.

Similarly, the majority of patients classified their ethnicity as "white" in all of the papers besides one that was focused on Chinese cancer sufferers.[14] This could be an additional confounding factor, and may also bias the results, as other ethnicities are not fully represented . Furthermore, most of the

patients included in the studies were well educated. This could mean that they are more likely to attend sessions and comply with the interventions, which again could change the results slightly so that they could not be reliably applied to the general population.

Another limitation of some of the papers is the selection criteria. Many of the studies used referrals from support groups; this cohort of people are more likely to comply with the interventions and agree to take part in research. This could have been a cause of selection bias on the results. Palliative patients were excluded, and it is possible that they have more significant sleep disorders than cancer patients with curative treatment plans.

Clinical implications

Oncology patients have a need for effective psychological interventions to treat insomnia. This review has shown that all of the psychological interventions are useful for improving sleep disturbances in cancer patients, but MBSR and professionally administered group CBT may be the most effective. Individual CBT may also be useful for patients that do not have time to attend CBT sessions, or when there is a lack of trained CBT healthcare staff. All of the interventions mentioned in this review could potentially be used to treat insomnia in oncology effectively.

Research implications

Future RCTs need to be carried out to compare the effectiveness of CBT-I against MBSR for insomnia in cancer. Research would need to study other types of cancer apart from breast cancer and include a higher number of male patients and different ethnicities. Such a study design has been suggested by one paper already,[37] but has not yet been carried out and published. Additional RCTs also need to be carried out to test the effectiveness of self-hypnosis, PMR and autogenic training (AT) therapies for insomnia in cancer to establish how reliable the results of the original studies discussed in this review are.

Limitations

The main weakness of this review stems from the limitations of the articles that were discussed in the "Critical Appraisal" section; mainly the fact that some of the articles used in this review were only available as abstracts[11,12,14,15,22,23,25,26] and therefore not all of their data could be reviewed.

Conclusion

In conclusion, CBT-I and MBSR may be the most effective interventions in the treatment of insomnia in cancer, but further RCTs need to be carried out to evaluate which would be the most effective intervention to use for oncology patients suffering with sleep problems.

Learning Points

What is known already

- Sleep problems affect 30–50% of oncology patients.
- Sleep problems can potentially be very harmful for patients with cancer, for example by reducing immunity.
- The current recommended treatment for insomnia by NICE is sedative, hypnotic drugs.
- Sleep problems in oncology patients need to be treated with psychological interventions, rather than drugs.

What this study adds

- MBSR and CBT seem to be the most effective psychological interventions for insomnia in oncology patients.
- Self-help CBT is an effective alternative when professionally administered CBT is not available.
- Group CBT seems to be more effective than individual CBT.
- Further RCTs comparing the effectiveness of MBSR and CBT for sleep problems in cancer patients need to be carried out.

Appendix Table 9. The main characteristics of the papers included in this systematic review

Title and authors	Study design	Duration of study	Sample size	Characteristics of sample	How insomnia is measured	What is being tested	How results are measured	Results
Initial evaluation of an Internet intervention to improve the sleep of cancer survivors with insomnia – Ritterband LM *et al.*[4]	Randomized controlled trial (RCT)	9 weeks	28	Any type of cancer (18 breast, 10 other) Average age 56.7 years 24 female, 4 male Race: 26 white, 1 black, 1 mixed race Average 3.9 years since completion of active treatment for cancer Average 6.4 years of sleep difficulty	Participants had to meet the DSM-IV-TR (*Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision)* definition of insomnia, and: suffer from poor sleep for more than 6 months; difficulty sleeping at least 3 nights a week; less than an average of 6.5 hours of sleep per night over the last month; and daytime consequences.	Online CBT-I ("Sleep Healthy Using The Internet" (SHUTi)) vs waitlist control group.	Online questionnaires and daily sleep diaries. ISI, sleep efficiency and total sleep time.	The internet group presented significant improvements compared with the control group.
The influence of mindfulness-based stress reduction on objective sleep among breast cancer survivors – Lengacher C *et al.*[11]	RCT (abstract only)	6 weeks	79	Breast cancer survivors (stage 0, I, II, or III) Average age 57 years Ethnicity: 76% White Non-Hispanic; 9% White Hispanic; 10% Black Non-Hispanic; 4% Black Hispanic; and 1% other. Cancer treatment: 22 (28%) radiation only; 23 (29%) radiation and chemotherapy; 10 (13%) chemotherapy only; 24(30%) neither.	Unknown	Mindfulness based stress reduction (MBSR) vs treatment as usual	Actigraph watch, measuring: Sleep efficiency Sleep onset latency Number of night time awakenings	The MBSR group did not differ from the control group at 6 weeks, but at 12 weeks sleep quality seemed to be better in the MBSR group (especially with fewer night time awakenings).
Is a video-based cognitive-behavioral therapy as efficacious as a professionally administered treatment for insomnia comorbid with cancer? Preliminary results of a randomized controlled trial – Savard J *et al.*[12]	RCT (abstract only)	Unknown	251	Breast or gynaecological cancer patients All women	Unknown	Video-based cognitive-behavioural therapy for insomnia (CBT-I) compared with professionally administered CBT-I and no treatment control group	Insomnia Severity Index (ISI) score; daily sleep diary including: sleep onset latency; wake after sleep onset; early morning awakening; total wake time; total sleep time; sleep efficiency.	No significant difference between the video-based CBT-I and professionally administered CBT-I except for total sleep time. Professionally administered still appears to be better than video based.

Feasibility of a self-help treatment for insomnia comorbid with cancer – Savard J *et al.*[13]	Pilot study	6 weeks (+ 3 month follow-up)	11	Non-metastatic breast cancer patients All patients had previously received radiation therapy for cancer Average age 51.5 years	Score of 8 or higher on the Insomnia Severity Index (ISI), or use a psychotropic drug to help sleep for 3 nights a week or more.	Video-based CBT – no control group	Semi-structured interviews, self-report scales and a daily sleep diaries. Treatment Perception Questionnaire; Treatment Satisfaction	Sleep was much improved. However, many limitations to the study. (e.g. small sample size, no control group)
An evaluation of the effectiveness of psychosocial group programmes for treating insomnia in Chinese cancer patients – Raymond CLC[14]	Quasi-experiment	Unknown	64	Any type of cancer Chinese patients	Unknown	Multimodal group CBT (emotional-stress reduction, relaxation training, cognitive restructuring, sleep hygiene education,) – no control group	ISI, DBAS, Beck Anxiety Inventory (BAI), General Health Questionnaire – 12 Questions (GHQ-12).	Significant progress in all interventions.
Cognitive behavioral therapy for insomnia comorbid with cancer: Efficacy of an early and minimal intervention – Casault L *et al.*[15]	RCT (abstract only)	6 weeks (+ 3/6 month follow-up)	38	Any type of cancer	Symptoms of insomnia for less than 6 months.	Minimal CBT (carried out on own: bibliotherapy) vs no treatment control group	Self-report scales, daily sleep diaries, ISI.	Significant improvement in the CBT group compared with the control group on sleep, anxiety, depression, fatigue, dysfunctional beliefs about sleep.
Randomized controlled clinical effectiveness trial of cognitive behavior therapy compared with treatment as usual for persistent insomnia in patients with cancer - Espie CA *et al.*[16]	RCT	5 weeks (+ 6 month follow-up)	150 (106 completed whole trial)	Breast, prostate, colorectal or gynaecological cancer (breast most common (58%)) 103 females, 47 males Mean age 61 years Cancer treatment finished 1 month or more previously Mean insomnia duration of 28.5 months	Pittsburgh Sleep Quality Index (PSQI) score of more than 5. Longer than an average of 30 minutes for delayed sleep-onset latency and/or wake time after sleep onset occurring 3 or more nights a week for 3 or more months, and having daytime affects.	Professionally administered CBT (small group sessions) vs treatment as usual control group	Daily sleep diary, actigraphy, quality of life, psychopathology, fatigue.	Average reduction in wakefulness of 55 mins per night in CBT group – no change in control group. General improvements in QOL, fatigue, and daytime wellbeing.

Randomized study on the efficacy of cognitive-behavioral therapy for insomnia secondary to breast cancer, part I: Sleep and psychological effects – Savard J et *al.*[17]	RCT	8 weeks (+ 3/6/12 month follow-up)	57 (53 finished treatment; 40 attended all follow-ups)	Breast cancer patients (stage I to III) All women Finished radiotherapy/chemotherapy 1 month or more previous to the trial Race: all white Mean age 54.09 years	Insomnia diagnosed by the International Classification of Sleep Disorders and the *DSM-IV*, as well as: sleep-onset latency and/or wake after sleep onset for more than 30 minutes; sleep efficiency lower than 85%; problems for 3 or more nights a week; problems for 6 or more months; affected daytime functioning.	Small-group CBT (using stimulus control, sleep restriction, cognitive therapy, sleep hygiene, and fatigue management) vs waiting list control group.	Daily sleep diary, ISI, Insomnia Interview Schedule (IIS), polysomnography, Hospital Anxiety and Depression Scale (HADS), Multidimensional Fatigue Inventory, The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire.	CBT group had significantly better sleep indices, less medicated nights, lower depression and anxiety levels, and greater quality of life than the control group post-treatment.
Efficacy of cognitive-behavioral therapy for insomnia in women treated for nonmetastatic breast cancer – Quesnel C et *al.*[18]	Quasi-experiment	8 weeks (+ 3/6 month follow-up)	10 (2 dropped out of treatment, 6 attended all follow-ups)	Breast cancer patients (non-metastatic, stage I, II or III) Completed cancer treatment 1 month of more previously Mean age 54.3 years Mean insomnia duration 16.9 years	Meet insomnia criteria of the International Classification of Sleep Disorders and *DSM-IV*, and: sleep-onset latency and/or wake after sleep onset for more than 30 minutes; sleep efficiency lower than 85%; problems for 3 or more nights a week; problems for 6 or more months; affected daytime functioning.	Professionally-administered group CBT (behavioural, cognitive and educational approaches, including sleep hygiene) – no control group	IIS, daily sleep diary, polysomnography, ISI, Structured Clinical Interview for DSM–IV Axis I Disorders (SCID), Back Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI), Multidimensional Fatigue Inventory (MFI), Quality of Life Questionnaire (QLQ-C30).	Significant improvements in total wake time and sleep efficiency.
Feasibility and preliminary efficacy of a self-hypnosis intervention available on the web for cancer survivors with insomnia – Farrell-Carnahan L et *al.*[19]	RCT	4 weeks	28	18 breast cancer patients, 10 other type of cancer 86% women (24 female, 4 male) Race: 26 white, 1 black, 1 more than one race Mean age 56.7 years Mean 6.4 years of sleep difficulties	ISI score greater than 8.	Self-hypnosis available on the internet vs waitlist control group.	Daily sleep diaries, ISI.	Small improvements in sleep – not statistically significant. Need further trials with larger sample sizes.
Cognitive behavioral therapy for insomnia in breast cancer survivors: A randomized controlled crossover study – Fiorentino L[20]	RCT	12 weeks (6 weeks treatment + 6 weeks follow-up)	14	Breast cancer patients Mean age 61 years Race: 12 Caucasian, 1 Asian, 1 more than one race All participants had finished cancer treatment	Meet DSM-IV criteria. Insomnia symptoms 3 times a week or more for at least a month.	Professionally-administered individual CBT-I (educational/cognitive/behavioural components) vs treatment as usual control group.	Daily sleep diaries, actigraphy, ISI, PSQI, Multidimensional Fatigue Symptom Inventory (MFSI-SF), Medical Outcomes Study Short Form 36 item Health Survey (SF-36), Functional Outcomes of Sleep Questionnaire (FOSQ), Center of Epidemiological Studies-Depression (CES-D) scale, Brief Symptom Inventory (BSI-18)	Significant improvements in self-rated insomnia, sleep quality and objective sleep measurements.

Efficacy of an insomnia intervention on fatigue, mood and quality of life in breast cancer survivors – Dirksen SR et *al.*[21]	RCT	10 weeks	81 (72 completed trial)	Breast cancer patients (stages I, II or III) All women Completed primary treatment at least 3 months previously Mean age 58 years Race: 96% white Mean duration of insomnia 5 years	Sleep-onset latency and/or wake after sleep onset for more than 30 minutes; sleep disturbances for at least 3 months; affected daytime functioning.	Professionally administered group CBT-I (composed of stimulus control instructions, sleep restriction therapy and sleep education and hygiene) versus sleep education and hygiene only (control group)	ISI, Profile of Mood States Fatigue/Inertia Subscale (POMSF/I), STAI, Center for Epidemiologic Studies-Depression Scale (CES-D), Functional Assessment of Cancer Therapy-Breast (FACT-B).	CBT-I group had significant improvements in fatigue, anxiety, depression and quality of life. Control group had significant improvements in quality of life.
Psychological effects of Cognitive Behaviour Therapy (CBT) for persistent insomnia associated with cancer: randomized controlled trial (RCT) – Espie CA et *al.*[22]	RCT (abstract only)	5 weeks (+ 6 month follow-up)	150	Breast, prostate, gynaecological or colorectal cancer 103 females, 47 males Mean age 61 years	Unknown	Professionally administered small group CBTvs treatment as usual control group.	DBAS, Sleep Disturbance Questionnaire (SDQ)	CBT group had significant reductions in the DBAS and SDQ compared to the control group.
Treating insomnia associated with cancer: A randomized, multi-centre trial of cognitive behaviour therapy (CBT) delivered by cancer nurse specialists – Espie A et *al.*[23]	RCT (abstract only)	5 weeks (+ 6 month follow-up)	150	Mainly breast, prostate or colorectal cancer	Diagnosed of insomnia according to clinical and research criteria.	Professionally delivered group CBTvs treatment as usual control group.	Daily sleep diary, actigraphy	Average decrease in sleep-onset latency and wake time after sleep onset of about 60 mins per night in CBT group. Insignificant change in control group.
Investigating efficacy of two brief mind-body intervention programs for managing sleep disturbance in cancer survivors: A pilot randomized controlled trial – Nakamura Y et *al.*[24]	RCT	3 weeks (+ 2 month follow-up)	57	Mainly breast cancer (31), also ovarian, endometrial, testicular, prostate, lung, melanoma, ependymona, leukemia, kidney, lymphomas (non-Hodgkin's, CNS), skin carcinoma, brain, thyroid, and peritoneal cancers 9 metastatic cancers Completed cancer treatment at least 3 months previously Average age 52.6 years 43 females, 14 males	Medical Outcomes Study Sleep Scale (MOS-SS) Sleep Problems Index II score of 35 or more. No health professional diagnosis.	Mind–Body Bridging (MBB) and Mindfulness Meditation (MM) compared with sleep hygiene education (SHE) (control group)	Medical Outcomes Study Sleep Scale (MOS-SS), Functional Assessment of Cancer Therapy General (FACT-G), Perceived Stress Scale (PSS), CES-D, Impact of Event Scale (IES), Five-Facet Mindfulness Questionnaire (FF-MQ), Self-Compassion Scale, WHO Well-Being Index (WBI), Positive and Negative Affect Schedule (PANAS).	MBB and MM groups had reduced sleep disturbance symptoms compared with SHE group. MBB group also showed reduced depression symptoms, and improvements in mindfulness, self-compassion, and wellbeing levels.

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Evaluation of a focused intervention for sleep disturbance in a Cancer Nutrition-Rehabilitation program – Carney S et *al.*[25]	Retrospective study (abstract only)	8 weeks	52	Cancer Nutrition-Rehabilitation program patients	Edmonton Symptom Assessment Scale (ESAS) score of 4 or higher, and/or using the distress thermometer to report insomnia as a problem.	Focused interdisciplinary intervention (Individualized teaching and provision of written information on sleep hygiene). The interventional group was compared to a group that had received the program previous to its initiation.	PSQI, Edmonton Symptom Assessment Scale (ESAS)	PSQI and ESAS scores significantly improved in both groups. No significant difference between both groups in extent of improvement.
CBTI for insomnia after breast cancer treatment: Individual improvement in sleep outcomes – Matthews E et *al.*[26]	Pilot study (abstract only)	6 weeks	20	Breast cancer patients All women Average age 53.5 years All participants previously completed cancer treatment	Unknown	Professionally administered CBT-I individual intervention (including sleep restriction, stimulus control, sleep hygiene and cognitive therapy) – no control group	Daily sleep diary, hierarchical linear models (HLM)	Reduction in sleep latency. Increase in total sleep time, sleep efficiency and a positive rating of feeling "refreshed" upon awakening. Number of awakenings and overall quality of sleep did not improve significantly.
Sleep management training for cancer patients with insomnia – Simeit R et *al.*[27]	RCT	3-4 weeks (+ 6 week and 6 month follow-up)	229	Breast, kidney, prostate, bladder, lung, leukaemia, gynaecological, other cancer Mean age 58 years Mean duration of insomnia 101.3 months 172 females, 57 males All Caucasian Almost all of German origin	Patients with sleep disturbances.	Multimodal psychological sleep management programme (including sleep hygiene, cognitive techniques, relaxation techniques, and advice on stimulus control technique). 3 groups: progressive muscle relaxation (PMR), autogenic training (AT) and standard rehabilitation (control).	PSQI, Cancer Quality of Life Questionnaire 30 of the European Organisation for Research and Treatment (EORTC-QLQ-C30)	No differences between the two interventional groups. Sleep latency, sleep duration, sleep efficiency, sleep quality, sleep medication and daytime dysfunction all improved in the interventional groups compared with the control group.
The efficacy of mindfulness-based stress reduction in the treatment of sleep disturbance in women with breast cancer: An exploratory study – Shapiro SL et *al.*[28]	RCT (part of a larger study)	6 weeks (+ 3/9 month follow-up)	63	Breast cancer (stage II) All women Cancer-free at the time of the study Mean age 57 years Ethnicity: 54 non-Hispanic White, 5 Hispanic, 2 African American	None	Mindfulness-based stress reduction (MBSR) intervention (focussed on stress reduction). One group were given MBSR; the other control group could choose which stress management techniques to take part in each week.	Daily sleep diaries, Profile of Mood States Scale (POMS), BDI, Penn State Worry Questionnaire (PENN), State-Trait Anxiety Inventory, Functional Assessment of Cancer Treatment-Breast (FACIT-B), Shapiro Control Inventory (SCI), Sense of Coherence (SOC).	The MBSR and control groups both showed improvement in sleep quality, but not in sleep efficiency. Participants felt more refreshed on awakening after practicing mindfulness.

Impact of mindfulness-based stress reduction (MBSR) on sleep, mood, stress and fatigue symptoms in cancer outpatients – Carlson LE et *al.*[29]	Quasi-experiment	8 weeks	63	Breast (59%), prostate (6%), ovarian (6%), Non-Hodgkins lymphoma (6%), other (23%) cancers 49 women, 14 men Mean age 54 years	PSQI score of greater than 5 – 91% of the sample met this criteria	Mindfulness-based stress reduction (MBSR) intervention – no control group.	PSQI, Symptoms of Stress Inventory (SOSI), POMS	Reduced overall sleep disturbance and improved sleep quality. Reduced stress, fatigue and mood disturbance.
Randomized trial of a cognitive-behavioral intervention for insomnia in breast cancer survivors – Epstein DR et *al.*[30]	RCT	6 weeks	81 (72 completed the study)	Breast cancer patients (stage I, II or III) All women Finished primary cancer treatment at least 3 months previously Average age 58.1 years Average duration of insomnia 5.2 years Ethnicity: 1 Native American, 2 Black (Non-Hispanic), 69 White	Problems falling and/or staying asleep for 3 months or more; affected daytime functioning.	Professionally-administered group CBT: Intervention group (stimulus control instructions, sleep education, sleep hygiene, sleep restriction) and single-component control group (sleep education and hygiene only)	Daily sleep diaries, sleep-onset latency, wake after sleep onset, time in bed, sleep efficiency, total sleep time, sleep quality, actigraphy.	Both groups improved on sleep-onset latency, wake after sleep onset, total sleep time, time in bed, sleep efficiency, and sleep quality. The intervention group overall had more improved sleep than the control group.
Behavioral therapy intervention trial to improve sleep quality and cancer-related fatigue – Berger AM et *al.*[31]	RCT	2 weeks	219 (201 completed the study)	Breast cancer patients (stage I, II or III) All women Average age 52.15 years Ethnicity: 8 Hispanic, 211 Non-Hispanic Race: 209 White, 10 Non-White Undergoing chemotherapy treatment	None	CBT (Individualized Sleep Promotion Plan (ISPP)) - modified stimulus control, modified sleep restriction, relaxation therapy, and sleep hygiene, compared with control group that received healthy eating advice.	PSQI, daily sleep diary, actigraphy, Piper Fatigue Scale (PFS).	Improved quality sleep in the interventional group.

Table 10. *Self-help CBT ISI scores[32] compared with professionally administered scores*

Study	**Average ISI score[32] decrease (%)**	**Mean ISI score[32] post-treatment**	**Average ISI score[32] decrease in control group (%)**
Self-help CBT-I			
Ritterband LM *et al.*[4]	52.0	8.2	9.4
Savard J *et al.*[12]	44.5	8.1	Unknown
Savard J *et al.*[13]	45.2	8.6	No control group
Casault L *et al.*[15]	56.2	5.3	6.6
Professionally administered CBT-I			
Savard J *et al.*[12]	58.2	5.9	Unknown
Savard J *et al.*[17]	53.1	7.6	15.0
Quesnel C *et al.*[18]	63.9	6.1	No control group
Fiorentino L[20]	27.4	12.2	4.0
Dirksen SR *et al.*[21]	39.9	14.4	28.2

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