

# Adapting Cognitive-Behavior Therapy for Insomnia in Cancer Patients

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Insomnia disorder is common in patients undergoing cancer treatment. There is compelling evidence demonstrating that cognitive-behavioral therapy for insomnia (CBT-I) should be the initial treatment, but there has been insufficient research has been conducted among cancer patients. This population presents with unique physical and psychosocial health issues that may interfere with standard CBT-I and addressing these issues can play a role in improving treatment adherence and efficacy. We explore potential adaptations that can be made to standard CBT-I for cancer patients. Further research for this growing population is essential. **Sleep Med Res 2017;8(2):51-61**

**Key Words** Insomnia disorder, Cognitive behavioral therapy for insomnia, Sleep, Cancer patient, Supportive care.

## INTRODUCTION

Insomnia is characterized by difficulty falling asleep and/or staying asleep, resulting in daytime distress/dysfunction.<sup>1</sup> Among cancer patients receiving active treatment, insomnia is highly prevalent: it is estimated that upwards of 60% of patients experience insomnia symptoms, with over 25% meeting diagnostic criteria for insomnia disorder.<sup>2-4</sup> Insomnia that develops during cancer treatment is unlikely to remit over time. Evidence suggests that years after completing treatment, over 50% of cancer survivors continue to experience insomnia symptoms, with over 20% reporting clinically elevated symptoms.<sup>5-8</sup> Given the known physical and psychological health consequences of insomnia,<sup>9-11</sup> early identification and treatment of insomnia must be a clinical priority.<sup>12</sup> Taking a proactive approach to treating insomnia as close to its development as possible is important to minimizing the known impact of poor sleep on the health of cancer patients.<sup>3,13,14</sup>

## DEVELOPMENT OF INSOMNIA IN CANCER PATIENTS

Spielman's 3-P model is widely accepted for explaining the etiology and maintenance processes of chronic insomnia.<sup>15</sup> The model describes the predisposing, precipitating, and perpetuating factors for insomnia. Predisposing factors are biological or psychological factors that make an individual more likely to develop insomnia, such as female gender, or a family history of insomnia. Precipitating factors are the various triggering factors for acute insomnia, including an environmental or psychological stressor, acute illness, or medication side effects. Once insomnia disorder has developed, it can develop into chronic insomnia through maintenance by perpetuating factors, even though the factors that initially precipitated the sleep disruption.

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tions have diminished or disappeared. Some examples of perpetuating factors include maladaptive sleep behaviors, dysfunctional beliefs and thoughts, or excessive worries. The 3-P model is helpful not only to understand the etiology and maintenance of insomnia, but can also help to identify appropriate targets for proper treatment.

Patients with cancer are exposed to a myriad of precipitating factors for insomnia along the cancer trajectory (Table 1).<sup>16</sup> At the outset, a cancer diagnosis itself is a traumatic event that completely alters the course of the patient's life<sup>17</sup> and can precipitate insomnia.<sup>18</sup> Following diagnosis, typical cancer treatments including surgery, chemotherapy, radiation therapy, or hormone therapy are often intensive. The physical side effects and psychological distress associated with coping with these health changes during and following treatment can cause the development of insomnia.<sup>19-21</sup> Furthermore, medications used to manage treatment side effects (e.g., pain), and co-morbid medical disorders can independently cause insomnia. It is important to also recognize that cancer treatment occurs in an individual who will present with pre-existing psychosocial and health morbidities that can affect sleep. For example, the patient may have already been struggling with depression before their cancer diagnosis and treatment, which is known to impair sleep.<sup>3,12,14,22-24</sup> Patients with cancer may have a problem handling their acute insomnia symptoms not only because of fatigue or disrupted circadian rhythms that accompany with cancer treatment, but also because they are overly concerned about the negative impact of

insomnia on their health. Dysfunctional beliefs and thoughts can cause excessive fear and anxiety about insomnia, which ultimately lead to maladaptive behaviors such as spending too much time in bed to sleep more, habitual nap, or activities other than sleeping in bed.<sup>8,25,26</sup> In addition, relationship dysfunction between partners may become exacerbated following a cancer diagnosis,<sup>27,28</sup> which can impact sleep. Finally, environmental disruptions occur frequently during the cancer treatment (e.g., medical procedures or increased noise during hospitalizations) which interrupt sleep.

It is essential to note that though cancer and its associated treatments can precipitate insomnia, it is not always the case. Nearly 15% of patients had their first insomnia experience following cancer treatment,<sup>2</sup> 58% reported that cancer aggravated existing sleep problems.<sup>18</sup> This indicates that insomnia may have been a pre-existing morbidity that now necessitates treatment because the patient's health has been further compromised by cancer and its associated therapies.

## INSOMNIA TREATMENT IN CANCER PATIENTS

Despite known side effects, a goal of short-term use, and potential for interactions with cancer-directed therapies,<sup>29-32</sup> prescription and over-the-counter medications for insomnia are likely to be the most commonly dispensed form of treatment. Estimates vary, with between 20–50% of cancer patients taking some form of pharmacotherapy for their sleep problems.<sup>33-35</sup> This is unfortunate because cognitive-behavioral therapy for insomnia (CBT-I) is a non-pharmacological treatment for insomnia that is endorsed by the National Institutes of Health, American Academy of Sleep Medicine, and the American College of Physicians as the first line of treatment for adults with chronic insomnia.<sup>36-39</sup> This gap between the best evidence-based care, with actual clinical practice suggests that cancer centers must consider how to better screen for insomnia, and to provide adequate treatment opportunities for their patients.<sup>40</sup>

## COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA

### General Principles

CBT-I uses basic behavioral principles and conceptualization of insomnia disorder based on the 3-P model by resolving the perpetuating factors associated with maintaining insomnia, and relearning sleep behaviors that are more conducive to sleep. CBT-I is a short intervention that usually consists of 4–8 weekly sessions and is usually delivered as a multi-component treatment that includes sleep hygiene, stimulus control, sleep restriction, cognitive therapy, and relaxation training.<sup>41</sup> Currently, stimulus

**Table 1.** The 3-P model for insomnia among cancer patients<sup>8</sup>

Predisposing factors	Older age
	Female gender
	Personal or family history of psychiatric disorder
	Medical or psychiatric comorbidities
	Hyperarousability trait
Precipitating factors	Distress from cancer diagnosis and treatment
	Psychiatric symptoms (depression, anxiety, delirium)
	Cancer related symptoms (pain, fatigue, hot flashes)
	Cancer treatment (chemotherapy, radiotherapy, hormonal therapy)
	Certain medications
Perpetuating factors	Surgery or hospitalization
	Daytime napping
	Excessive time in bed
	Irregular sleep-wake schedule
	Sleep interfering activities (watching smartphone or TV in bed)
Unrealistic sleep expectations	
Faulty sleep appraisals	
Tendency to worry in bed	

control, sleep restriction, and cognitive therapy have been recognized as being effective treatments independently as standalone treatments for insomnia, while sleep hygiene and relaxation training are often considered adjunctive interventions.<sup>41</sup>

While CBT-I is usually divided into behavioral and cognitive components, a recent dismantling study compared full CBT-I, behavioral, and cognitive therapy found that while full CBT-I is the treatment of choice for treatment response and remission rates, both behavior therapy and cognitive therapy were effective.<sup>42</sup> However, behavior therapy produced rapid effects but did not sustain treatment effects, while cognitive therapy produced slower therapeutic effects, but was more helpful in maintaining treatment effects.

### CBT-I Trials in Cancer Populations

There is growing evidence that CBT-I is an effective treatment for reducing insomnia in cancer patients and survivors, regardless of cancer types, with breast cancer patients accumulating the most evidence to date in treatment response.<sup>43-45</sup> Traditional face-to-face CBT-I has been compared to self-help CBT-I, treatment as usual, mindfulness-based treatment, acupuncture, pharmacotherapy, Tai-Chi, behavior placebo treatment and control conditions in cancer patients.<sup>46-48</sup> For a more comprehensive review, see Garland et al.<sup>49</sup> and Johnson et al.<sup>50</sup> Table 2 is a summary of studies that have used CBT-I in cancer patients.

Studies in CBT-I for cancer patients have also yielded interesting secondary outcomes by improving sleep. While the results have been mixed, several studies have found psychological improvements in mood, such as anxiety, depression, stress.<sup>44,51,52</sup> Additionally, there has also been some evidence for improvements in fatigue and quality of life.<sup>44,52,53</sup> There has also been one study by Savard et al.<sup>54</sup> that have reported on improving physical outcomes. This study found that breast cancer patients treated with CBT-I also had improvements in immune functioning, with increases in interferon (IFN)-gamma, interleukin-1beta, with significant changes in white blood count, lymphocytes, and IFN-gamma also found in follow-up assessments after post-treatment.

## ADAPTING COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA IN CANCER PATIENTS

### Introduction

While the accumulating data for CBT-I in improving sleep and other psychological and physical domains looks promising, there appears to be several areas that require further attention. First, there appears to be significant participant drop-out in CBT-I trials conducted among cancer populations. The behavioral changes required of patients undergoing CBT-I would be difficult even in a healthy adult and when coupled with on-

going cancer-related issues, can seem insurmountable. Across 25 studies, drop-out rates ranged from 6.2–56.3%, with an average of approximately 1 in 5 participants prematurely terminating treatment. While there have been no studies of predictors of drop-out in CBT-I patients with cancer, a study by Ong et al.<sup>55</sup> about predictors of drop-out in the general population reported that having an average total sleep time of < 3.65 hours and depression scores of greater or higher than 16 on the Beck Depression Inventory at baseline were predictors of early treatment termination. Considering these variables, it will be important to identify predictors of adherence or drop-out to enhance treatment effects. Additionally, most of the studies to date that have investigated CBT-I in cancer patients have used a standardized manual developed for insomnia patients, without tailoring specifically to the cancer population. Several additional improvements, such as including CBT-I components in existing psychosocial interventions for cancer patients to deliver a more comprehensive treatment package that specifically address psychological symptoms of cancer, or developing CBT-I manuals to specifically address challenges that are often reported in cancer patients that are associated with sleep, may be able increase treatment effects as well as improve overall quality of life in the long-term in cancer patients and survivors.

### Sleep Restriction

Sleep efficiency commonly guides the treatment of insomnia and describes the ratio of total sleep time compared to time spent in bed. High sleep efficiency is ideal, with a sleep efficiency of at least 85–90% often used as a marker for good sleep. Longer time spent in bed awake (without associated increases in sleep) will decrease sleep efficiency, so the first step in consolidating sleep during CBT-I is restricting time in bed. Sleep restriction therapy requires placing an initial limit on the amount of time permitted in bed, with the goal of helping patients reduce sleep onset latency and wake after sleep onset by increasing their homeostatic drive for sleep.<sup>56</sup> The patient's sleep outcomes are usually tracked using daily sleep diaries,<sup>57</sup> with relevant terms seen in Table 3. This CBT-I component often proves difficult for patients because of the initial, brief period of sleep deprivation that occurs. Patients with cancer can struggle even more as they frequently suffer from symptoms of fatigue related to their cancer-directed therapies (e.g., chemotherapy, radiotherapy), or the cancer itself, which results in physical, emotional, and cognitive tiredness or exhaustion.<sup>58</sup> The prevalence of cancer-related fatigue is high,<sup>59</sup> thus it is essential to incorporate a discussion of how to address this in the context of sleep restriction for cancer patients prepare strategies for reducing cancer-related fatigue and providing patients with treatment rationale and sleep education when implementing sleep restriction. For example, patients may report that they are simply too exhausted following a course of treatment to be able to remain awake until their adjusted bedtime. It may be necessary to relax the sleep

**Table 2.** Studies of cognitive-behavioral therapy for insomnia in cancer patients

Author	Sample size	Type of cancer	# of sessions	Format	Delivery mechanism	Drop-out rate (%)
Davidson et al. <sup>100</sup>	CBT-I = 12	Breast, lymphoma, cervix, melanoma	6	Group (4-6)	Face-to-face	CBT-I = 14.28
Quesnel et al. <sup>101</sup>	CBT-I = 10	Breast cancer	8	Group	CBT-I = face-to-face (session 1-8)	CBT-I = 20.00
Savard et al. <sup>43</sup>	Full sample = 57, CBT-I = 27, WLC = 30	Breast cancer	8	Group (4-6)	CBT-I = face-to-face (session 1-8)	N/A
Epstein & Dirksen <sup>102</sup>	Full sample = 81, CBT-I = 40, sleep education = 41	Breast cancer	6	Group and individual	CBT-I = face-to-face (group session 1, 2, 3, 4), telephone (individual session 5, 6)	Total = 11.11 CBT-I = 15.00 Control group = 7.31
Dirksen & Epstein <sup>103</sup>	Full sample = 81, CBT-I = 40, component control = 41	Breast cancer survivor	6	Group and individual	CBT-I = face-to-face (group session 1, 2, 3, 4), telephone (individual session 5, 6)	Total = 8.64 CBT-I = 10.00 CC = 7.31
Espie et al. <sup>44</sup>	Full sample = 150, CBT-I = 100, TAU = 50	Breast, prostate, colorectal, gynecological cancer	5	Group (4-6)	CBT-I = face-to-face (session 1, 2, 3, 4, 5)	Total = 14.66 CBT-I = 15.00 Control group = 14.00
Fiorentino et al. <sup>104</sup>	Full sample = 21, CBT-I = 11, control = 10	Breast cancer	6	Individual	CBT-I = face-to-face (session 1-6)	Total = 33.33 CBT-I = 45.45 Control group = 20.00
Garland et al. <sup>105</sup>	Full sample = 110, CBT-I = 55, MBSR = 55	Cancer survivor (no restrictions on tumor location)	8	Group (6-10 individuals)	Face-to-face	N/A
Savard et al. <sup>51</sup>	CBT-I = 11	Breast	N/A	Individual	Self-CBT-I: DVD and booklet	0
Matthews et al. <sup>45</sup>	Full sample = 60, CBT-I = 30, BPT = 30	Breast cancer	6	Individual	Face-to-face (session 1-3, 6), phone (session 4, 5)	N/A
Ritterband et al. <sup>96</sup>	Full sample = 28, internet CBT-I = 14, control = 14	Any cancer type (93% breast cancer)	6	Individual	Internet (session 1-6)	0
Savard et al. <sup>53</sup>	Full sample = 242, PCBT-I = 81, VCBT-I = 80, control = 81	Breast cancer	PCBT-I = 6 VCBT-I = 6	Individual	PCBT-I = face-to-face (session 1-6), VCBT-I = video (session 1-6)	Total = 15.70 PCBT-I = 13.58 VCBT-I = 28.75 Control = 4.93
Fleming et al. <sup>106</sup>	Full sample = 113, CBT-I = 73, TAU = 40	Breast, prostate, bowel, gynaecological	5	Group	Face-to-face	Total = 24.66 CBT-I = 27.00 TAU = 20.00

**Table 2.** Studies of cognitive-behavioral therapy for insomnia in cancer patients (continued)

Author	Sample size	Type of cancer	# of sessions	Format	Delivery mechanism	Drop-out rate (%)
Garland et al. <sup>46</sup>	CBT-I = 47	Breast cancer 23, prostate 3, blood/lymph 3, female genitourinary 4, colon/GI 2, head and neck 2, lung 3	8	Group (6-10 individuals)	Face-to-face	21.28
Matthews et al. <sup>107</sup>	Full sample = 60, CBT-I = 32, BPT = 28	Breast cancer	6	Individual	Face-to-face (session 1, 2, 3, 6), phone (session 4, 5)	Total = 6.66 CBT-I = 6.25 BPT = 7.14
Garland et al. <sup>108</sup>	Full sample = 72, MBCT = 32, CBT-I = 40	Breast cancer 23, prostate 3, blood/lymph 3, female genitourinary 4, lung 3, head and neck 2, colorectal 2	8	Group (6-10 individuals)	Face-to-face	N/A
Casault et al. <sup>109</sup>	Full sample = 38, self-help CBT-I = 20, control = 18	Breast, colorectal, other (lung, prostate, bowel, tongue, vulva)	6	Individual	Self-help CBT-I: booklets + phone	Self-help CBT-I = 15.00
Roscoe et al. <sup>110</sup>	Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24	Any cancer (breast cancer 68%)	7	Individual	Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)	Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16
Garland et al. <sup>111</sup>	Full sample = 160, CBT-I = 65, acupuncture = 65	Any cancer type	7	Individual	Face-to-face	N/A
Garland et al. <sup>47</sup>	Full sample = 88, CBT-I + placebo = 21, CBT-I + armodafinil = 22, placebo = 23, armodafinil = 22	Any cancer type	7	Individual	Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)	17.04% for total sample
Heckler et al. <sup>112</sup>	Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24	Any cancer type (68% breast cancer)	7	Individual	Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)	Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16
Irwin et al. <sup>48</sup>	Full sample = 90, CBT-I = 45, TCC = 45	Breast cancer	12	Group (7-10)	Face-to-face (session 1-12)	CBT-I = 56.30 TCC = 53.30

**Table 2.** Studies of cognitive-behavioral therapy for insomnia in cancer patients (continued)

Author	Sample size	Type of cancer	# of sessions	Format	Delivery mechanism	Drop-out rate (%)
Kamen et al. <sup>113</sup>	Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24	Any cancer type (68% breast cancer)	7	Individual	Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)	Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16
Peoples et al. <sup>114</sup>	Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24	Any cancer type (68% breast cancer)	7	Individual	Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)	Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16
Zhou et al. <sup>97</sup>	Full sample = 12, in person CBT-I = 6, videoconference CBT-I = 6	Leukemia/lymphoma (60%) solid tumor (40%)	3	Individual	In person CBT-I = face-to-face (session 1-3), videoconference CBT-I = face-to-face (session 1), video (session 2, 3)	Total = 16.66 In person CBT-I = 100.00 Videoconference CBT-I = 33.33

CBT-I: cognitive behavioral therapy for insomnia, WLC: waiting-list control condition, N/A: not applicable, CC: component control, TAU: treatment as usual, GI: gastro-intestinal, MBSR: mindfulness-based stress reduction, BPT: behavioral placebo treatment, PCBT-I: professionally administered CBT-I, VCBT-I: video-based CBT-I, MBCR: mindfulness-based cancer recovery, TTC: Tai Chi Chih.

restriction schedule for some patients who cannot comply with their prescribed sleep window, for physical or psychological reasons (or both). Alternatively, a more gradual restriction of time in bed (known as sleep compression) can also be utilized as a therapeutic alternative to sleep restriction for patients who have high anxiety about making drastic changes to their time spent in bed.<sup>60</sup> Alternatively, it may be wise to determine a period of time during their treatment cycle to initiate treatment as that window of opportunity may provide a clinician with the best chances for success. This all requires a careful discussion with the patient to ensure that the adapted sleep schedule is not simply bending to a common, but inaccurate, view that brief sleep restriction is impossible and/or harmful. Further, for some patients, their efforts at improving sleep may simultaneously present a unique opportunity to also work on improving fatigue outcomes given the overlap in symptom presentation.<sup>61,62</sup>

### Stimulus Control

The basis for stimulus control therapy is the notion that the patient's bed is no longer an effective discriminative stimulus for sleep onset and/or maintenance because it has consistently been associated with other activities in bed.<sup>63</sup> For example, a patient who cannot sleep may lay in bed on their cell phone, watching television, or simply be trying to get back to sleep by laying still. The approach to addressing this is to inform patients that they can only use their bed for sleep (and sexual activity), but must leave the bed if they are unable to sleep for a pre-determined duration (e.g., 15 minutes).<sup>64</sup> Stimulus control has been demonstrated to be effective by itself as a treatment for insomnia in adults.<sup>65</sup> This can be a difficult portion of treatment to implement for a cancer patient. During hospitalizations, and even in outpatient care, they have often been instructed to remain in bed (or on a couch) by their providers in order to 'get as much rest as possible.' This often occurs during the daytime, with napping a common occurrence, and disruptions to a healthy sleep/wake schedule may influence their sleep onset, maintenance, and quality of sleep in the evening.<sup>66</sup> A thoughtful discussion with the patient focused on their inaccurate perceptions of benefits accrued by spending an excessive amount of time in bed not sleeping, and the potential improvements should they get out of bed, can be helpful. It is also reasonable to gently remind the patient that their pattern of spending time in bed has not resulted in improvements to their daytime function or nighttime sleep. Helping the patient identify pleasurable activities to distract them in the late evening/early morning when they are unable to sleep and must remain out of their bed is essential to success. The enlistment of a partner, family member, or friend's support can be crucial.

### Cognitive Therapy

The cognitive therapy component of CBT-I applies traditional techniques of cognitive therapy developed by Beck and

**Table 3.** Sleep indices to explore individual's sleep structure

Abbreviation	Sleep index	Definition
SOL	Sleep onset latency	20, 30, 45 minutes
TIB	Time in bed	7 hours: 11 pm–6 am
TIB/d <sup>115</sup>	Time in bed during 24 hours	7–8 hours
TST	Total sleep time	7–8 hours
SE	Sleep efficiency	85, 90%
WASO	Wake after sleep onset	20, 30, 45 minutes
PTB <sup>116</sup>	Duration from administration of pills to bedtime	< 30 minutes
PTS <sup>116</sup>	Duration from administration of pills to sleep onset time	< 30 minutes
PTW <sup>116</sup>	Duration from administration of pills to wake up time	7–8 hours

colleagues<sup>67,68</sup> in challenging and restructuring maladaptive and dysfunctional beliefs and attitudes that maintain insomnia. The main purpose of cognitive therapy is to modify the following beliefs: 1) unrealistic expectations about sleep needs and daytime functioning, 2) misattributions about the causes of insomnia, 3) catastrophizing the effects of the consequences of insomnia, and 4) dysfunctional beliefs about ways to improve sleep. Additionally, it is often helpful to discuss coping strategies to help the patient manage the negative daytime effects of insomnia. Cognitive therapy techniques can be utilized in different ways. Oftentimes, an adjunctive questionnaire such as the Dysfunctional Beliefs and Attitudes about Sleep Scale<sup>69</sup> or Glasgow Contents of Thoughts Inventory<sup>70</sup> is used to understand the nature and content of thoughts associated with insomnia. Some therapists use a daily mood log that patients can use in-session and for homework that identifies specific situations associated with sleep, automatic thoughts, and emotions associated with the automatic thoughts. Classical Socratic questioning techniques can be used in session to elicit more adaptive and realistic cognitions to replace the dysfunctional beliefs associated with sleep, and behavioral experiments can be used to challenge faulty thinking. Ultimately, the patient becomes practiced at identifying their cognitive distortions and maladaptive thoughts associated with sleep, and becomes able to modify their thoughts without the help of a therapist.

There are several distinctive dysfunctional beliefs about sleep that cancer patients may report, such as 'Not going to sleep at a certain time will have a serious effect on my immune system' or 'If I do not sleep well at night, my cancer may recur or metastasize.'<sup>71</sup> To some degree, these concerns may have some merit.<sup>72</sup> The former is supported by the fact that melatonin affects immunity, and it is also true that melatonin is secreted more at a certain time.<sup>73</sup> In the latter case, there are also several studies reporting associations between cancer incidence and mortality, with sleep duration.<sup>74-76</sup> However, cancer patients may be exposed to this information repeatedly through mass media, which may result in exaggerated and distorted dysfunctional beliefs about these consequences of poor sleep. Worrying about

sleep may in fact cause additional stress, which may subsequently have a deleterious effect on their health. In fact, it has been demonstrated that stress reactions related with excessive anxiety and fear may increase cortisol levels, which affects one's immune system.<sup>77,78</sup> In addition, these negative emotional states can exacerbate insomnia symptoms. Thus, when applying cognitive therapy to patients with cancer, it is important to help the patient understand that avoiding repeatedly thinking about the consequences of insomnia is the best way to break the vicious cycle and sleep well. This can be particularly important during the sleep restriction phase of CBT-I, where it is helpful to explain to patients that this brief period of poor sleep is unlikely to cause enduring health consequences, and in fact, is likely to improve their function in the long-term.

### Sleep Hygiene

The term "sleep hygiene" refers to behaviors that promote improved quantity and quality of sleep.<sup>79</sup> There lacks a clear consensus as to what specifically comprises sleep hygiene, though these rules are generally guided by the overarching principles to avoid sleep interfering behaviors and to increase sleep promotion behaviors. Examples of sleep hygiene principles include: 1) decreasing time in bed, 2) regular bed/wake times, 3) exercise, 4) eliminate bedroom noise, 5) regulate bedroom temperature, 6) light snack at bedtime, 7) avoid caffeine/alcohol consumption, 8) eliminate bedroom clock, and 9) relaxing activities before bed.<sup>80</sup> The American Academy of Sleep Medicine recommends sleep hygiene education as a part of treatment of insomnia,<sup>39</sup> though evidence suggests that sleep hygiene therapy as a single treatment modality for insomnia is likely to be ineffective. This may be due to several factors, such as many patients simply receiving a sleep hygiene handout, without any guidance or support on how and when to implement these strategies, vague and/or inconsistent sleep hygiene instructions.<sup>81</sup> A patient's sleep hygiene behaviors can be explored via a clinical interview, or can be assessed using a questionnaire such as the Sleep Hygiene Index.<sup>82</sup> There have been several studies which have explored the effectiveness of sleep hygiene on insomnia

among cancer patients as a single modality, and most studies combined sleep hygiene with relaxation training or other modalities.<sup>83,84</sup> It is likely that poor sleep hygiene practices can influence insomnia severity, but may not necessarily independently be sufficient to completely resolve symptoms. Several examples of sleep hygiene issues that arise for cancer patients include difficulty with maintaining consistent sleep/wake schedules and daytime napping, which is associated with compromised sleep quality.<sup>85</sup> These sleep hygiene issues may develop during an inpatient hospitalization, especially if patients must share a room with others.<sup>86</sup> Clinicians working with cancer patients on addressing sleep hygiene concerns must ensure that they engage in a thoughtful conversation about the importance of maintaining proper sleep hygiene, and to set proper expectations that improving sleep hygiene factors is likely to create incremental improvements to sleep rather than completely overhaul how well the patient is sleeping.<sup>87</sup>

### Relaxation

There has been a considerable history of the use of relaxation techniques to the treatment of insomnia. Relaxation approaches have included progressive muscle relaxation, autogenic training, and imagery among others.<sup>88-91</sup> It does not appear to be as effective as other components of CBT-I (e.g., stimulus control) by itself,<sup>92</sup> but does promote improved sleep. There is evidence to suggest that relaxation therapy can be a helpful intervention among cancer populations,<sup>93</sup> with a possible secondary benefit of also improving fatigue.<sup>94</sup> The use of some relaxation techniques can be challenging for cancer patients. For example, requires the individual to tense their muscles, which can be difficult for some patients following treatment (e.g., surgery). In addition, asking a patient who has never practiced relaxation before to consistently independently perform relaxation exercises is unlikely without some form of structured support.<sup>95</sup> Discussing which relaxation strategies are suitable for the particular patient and recognizing potential physical limitations and potentially working with other providers (e.g., physical therapist) to ensure they are appropriate can be helpful. In addition, working directly with patients to identify possible barriers to consistent practice of relaxation exercises and trying to find solutions to these issues (i.e., enrollment in group classes at their cancer center) can improve compliance with treatment recommendations.

### Intervention Delivery

Most clinical trials conducted of CBT-I in cancer populations have been performed in-person and have usually remained faithful to the standard protocol of 4–8 sessions.<sup>50</sup> This has major implications for limiting patient access should they not have the fortune of receiving medical care at a research-focused cancer center where a CBT-I trial is being conducted. Efforts have been undertaken to trial self-help, video, web, and telehealth CBT-I in

order to address treatment access barriers, with compelling evidence suggesting that these novel delivery mechanisms can be successful.<sup>51,53,96,97</sup> However, major challenges remain with respect to adequate screening for insomnia in cancer programs.<sup>40</sup> In combination with the low likelihood that a patient with insomnia will seek professional treatment,<sup>98</sup> there remain vital public health and medical provider education training gaps that should be addressed in order to help cancer patients get the evidence-based insomnia treatment that they require.

## CONCLUSION

Insomnia is common along the cancer trajectory, with good reason to believe that it will develop during cancer treatment for a sizable number of patients. In the general, and cancer-survivor populations, there have been many trials which have demonstrated that CBT-I is effective at improving insomnia symptomatology, mood, and quality of life. However, there have been fewer trials which have explored how such an approach can be adapted to respond to the cancer-related issues that are experienced by patients undergoing active cancer-directed therapies. Many of the core CBT-I treatment components may be difficult to fully implement in a patient who is receiving cancer treatment, and compromises are often made in the clinical setting in response to these challenges. The future exploration of how this can occur in a structured approach is necessary. Whether it will be advantageous to embed cancer-related content within standard CBT-I protocols, or if it is advisable to build a separate ‘cancer module’ to complement existing content, or a combination of these approaches, is an interesting question that researchers have yet to fully address. For the 14+ million patients diagnosed with cancer worldwide every year,<sup>99</sup> this is a clinically important line of research that must be pursued.

### Conflicts of Interest

The authors have no financial conflicts of interest.

### Authors' Contribution

Conceptualization: Zhou ES, Chung S. Data curation: Suh S. Project administration: Chung S. Writing—original draft: Zhou ES, Suh S, Youn S, Chung S. Writing—review & editing: Zhou ES, Suh S, Youn S, Chung S.

### REFERENCES

1. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*. Washington: American Psychiatric Association 2013.
2. Savard J, Ivers H, Villa J, Caplette-Gingras A, Morin CM. Natural course of insomnia comorbid with cancer: an 18-month longitudinal study. *J Clin Oncol* 2011;29:3580-6.
3. Palesh OG, Roscoe JA, Mustian KM, Roth T, Savard J, Ancoli-Israel S, et al. Prevalence, demographics, and psychological associations of sleep disruption in patients with cancer: University of Rochester Cancer Center-community clinical oncology program. *J Clin Oncol* 2010; 28:292-8.



4. Park B, Youn S, Hann C-WC, Yi K, Lee S, Lee JS, et al. Prevalence of insomnia among patients with the ten most common cancers in South Korea: health insurance review and assessment service-national patient sample. *Sleep Med Res* 2016;7:48-54
5. Zhou ES, Recklitis CJ. Insomnia in adult survivors of childhood cancer: a report from project REACH. *Support Care Cancer* 2014;22:3061-9.
6. Zhou ES, Manley PE, Marcus KJ, Recklitis CJ. Medical and psychosocial correlates of insomnia symptoms in adult survivors of pediatric brain tumors. *J Pediatr Psychol* 2016;41:623-30.
7. Gooneratne NS, Dean GE, Rogers AE, Nkwuo JE, Coyne JC, Kaiser LR. Sleep and quality of life in long-term lung cancer survivors. *Lung Cancer* 2007;58:403-10.
8. Savard J, Morin CM. Insomnia in the context of cancer: a review of a neglected problem. *J Clin Oncol* 2001;19:895-908.
9. Walsh JK, Üstün TB. Prevalence and health consequences of insomnia. *Sleep* 1999;22:S427-36.
10. Roth T. Insomnia: definition, prevalence, etiology, and consequences. *J Clin Sleep Med* 2007;3:S7-10.
11. Taylor DJ, Lichstein KL, Durrence HH. Insomnia as a health risk factor. *Behav Sleep Med* 2003;1:227-47.
12. Fleming L, Gillespie S, Espie CA. The development and impact of insomnia on cancer survivors: a qualitative analysis. *Psychooncology* 2010;19:991-6.
13. Palesh O, Aldridge-Gerry A, Zeitzer JM, Koopman C, Neri E, Giese-Davis J, et al. Actigraphy-measured sleep disruption as a predictor of survival among women with advanced breast cancer. *Sleep* 2014;37:837-42.
14. Redeker NS, Lev EL, Ruggiero J. Insomnia, fatigue, anxiety, depression, and quality of life of cancer patients undergoing chemotherapy. *Sch Inq Nurs Pract* 2000;14:275-90; discussion 291-8.
15. Spielman AJ, Caruso LS, Glovinsky PB. A behavioral perspective on insomnia treatment. *Psychiatr Clin North Am* 1987;10:541-53.
16. Lowery AE. Sleep and cancer. In: Holland JC, Breitbart WS, Butow PN, Jacobsen PB, Loscalzo MJ, McCorkle R. *Psycho-Oncology*. 3rd ed. New York: Oxford University Press 2015;231.
17. van't Spijker A, Trijsburg RW, Duivenvoorden HJ. Psychological sequelae of cancer diagnosis: a meta-analytical review of 58 studies after 1980. *Psychosom Med* 1997;59:280-93.
18. Savard J, Simard S, Blanchet J, Ivers H, Morin CM. Prevalence, clinical characteristics, and risk factors for insomnia in the context of breast cancer. *Sleep* 2001;24:583-90.
19. Savard J, Hervouet S, Ivers H. Prostate cancer treatments and their side effects are associated with increased insomnia. *Psychooncology* 2013; 22:1381-8.
20. Enderlin CA, Coleman EA, Cole C, Richards KC, Hutchins LF, Sherman AC. Sleep across chemotherapy treatment: a growing concern for women older than 50 with breast cancer. *Oncol Nurs Forum* 2010;37:461-A3.
21. Van Onselen C, Paul SM, Lee K, Dunn L, Aouizerat BE, West C, et al. Trajectories of sleep disturbance and daytime sleepiness in women before and after surgery for breast cancer. *J Pain Symptom Manage* 2013; 45:244-60.
22. Costa AR, Fontes F, Pereira S, Gonçalves M, Azevedo A, Lunet N. Impact of breast cancer treatments on sleep disturbances-a systematic review. *Breast* 2014;23:697-709.
23. Rumble ME, Keefe FJ, Edinger JD, Affleck G, Marcom PK, Shaw HS. Contribution of cancer symptoms, dysfunctional sleep related thoughts, and sleep inhibitory behaviors to the insomnia process in breast cancer survivors: a daily process analysis. *Sleep* 2010;33:1501-9.
24. Ancoli-Israel S. Recognition and treatment of sleep disturbances in cancer. *J Clin Oncol* 2009;27:5864-6.
25. Woodward SC. Cognitive-behavioral therapy for insomnia in patients with cancer. *Clin J Oncol Nurs* 2011;15:E42-52.
26. Graci G. Pathogenesis and management of cancer-related insomnia. *J Support Oncol* 2005;3:349-59.
27. Fergus KD, Gray RE. Relationship vulnerabilities during breast cancer: patient and partner perspectives. *Psychooncology* 2009;18:1311-22.
28. Holmberg SK, Scott LL, Alexy W, Fife BL. Relationship issues of women with breast cancer. *Cancer Nurs* 2001;24:53-60.
29. Walsh JK. Pharmacologic management of insomnia. *J Clin Psychiatry* 2004;65 Suppl 16:41-5.
30. Tariq SH, Pulisetty S. Pharmacotherapy for insomnia. *Clin Geriatr Med* 2008;24:93-105, vii.
31. Sideras K, Ingle JN, Ames MM, Loprinzi CL, Mrazek DP, Black JL, et al. Coprescription of tamoxifen and medications that inhibit CYP2D6. *J Clin Oncol* 2010;28:2768-76.
32. Lemmo W. Potential interactions of prescription and over-the-counter medications having antioxidant capabilities with radiation and chemotherapy. *Int J Cancer* 2015;137:2525-33.
33. Jaeger H, Morrow GR, Carpenter PJ, Brescia F. A survey of psychotropic drug utilization by patients with advanced neoplastic disease. *Gen Hosp Psychiatry* 1985;7:353-60.
34. Moore TA, Berger AM, Dizona P. Sleep aid use during and following breast cancer adjuvant chemotherapy. *Psychooncology* 2011;20:321-5.
35. Casault L, Savard J, Ivers H, Savard MH, Simard S. Utilization of hypnotic medication in the context of cancer: predictors and frequency of use. *Support Care Cancer* 2012;20:1203-10.
36. National Institutes of Health. National Institutes of Health State of the science conference statement on manifestations and management of chronic insomnia in adults, June 13-15, 2005. *Sleep* 2005;28:1049-57.
37. Wilson SJ, Nutt DJ, Alford C, Argyropoulos SV, Baldwin DS, Bateson AN, et al. British Association for Psychopharmacology consensus statement on evidence-based treatment of insomnia, parasomnias and circadian rhythm disorders. *J Psychopharmacol* 2010;24:1577-601.
38. Qaseem A, Kansagara D, Forcica MA, Cooke M, Denberg TD; Clinical Guidelines Committee of the American College of Physicians. Management of chronic insomnia disorder in adults: a clinical practice guideline from the American College of Physicians. *Ann Intern Med* 2016; 165:125-33.
39. Morgenthaler T, Kramer M, Alessi C, Friedman L, Boehlecke B, Brown T, et al. Practice parameters for the psychological and behavioral treatment of insomnia: an update. An american academy of sleep medicine report. *Sleep* 2006;29:1415-9.
40. Zhou ES, Partridge AH, Syrjala KL, Michaud AL, Recklitis CJ. Evaluation and treatment of insomnia in adult cancer survivorship programs. *J Cancer Surviv* 2017;11:74-9.
41. Smith MT, Smith LJ, Nowakowski S, Perlis ML. Primary insomnia: diagnostic issues, treatment, and future directions. In: Perlis ML, Lichstein KL. *Treating sleep disorders: principles and practice of behavioral sleep medicine*. 1st ed. Hoboken: John Wiley & Sons, Inc. 2003:214-61.
42. Harvey AG, Bélanger L, Talbot L, Eidelman P, Beaulieu-Bonneau S, Fortier-Brochu É, et al. Comparative efficacy of behavior therapy, cognitive therapy, and cognitive behavior therapy for chronic insomnia: a randomized controlled trial. *J Consult Clin Psychol* 2014;82:670-83.
43. Savard J, Simard S, Ivers H, Morin CM. Randomized study on the efficacy of cognitive-behavioral therapy for insomnia secondary to breast cancer, part II: Immunologic effects. *J Clin Oncol* 2005;23:6097-106.
44. Espie CA, Fleming L, Cassidy J, Samuel L, Taylor LM, White CA, et al. Randomized controlled clinical effectiveness trial of cognitive behavior therapy compared with treatment as usual for persistent insomnia in patients with cancer. *J Clin Oncol* 2008;26:4651-8.
45. Matthews EE, Schmiede SJ, Cook PF, Berger AM, Aloia MS. Adherence to cognitive behavioral therapy for insomnia (CBTI) among women following primary breast cancer treatment: a pilot study. *Behav Sleep Med* 2012;10:217-29.
46. Garland SN, Carlson LE, Stephens AJ, Antle MC, Samuels C, Campbell TS. Mindfulness-based stress reduction compared with cognitive behavioral therapy for the treatment of insomnia comorbid with cancer: a randomized, partially blinded, noninferiority trial. *J Clin Oncol* 2014;32:449-57.
47. Garland SN, Roscoe JA, Heckler CE, Barilla H, Gehrman P, Findley

- JC, et al. Effects of armodafinil and cognitive behavior therapy for insomnia on sleep continuity and daytime sleepiness in cancer survivors. *Sleep Med* 2016;20:18-24.
48. Irwin MR, Olmstead R, Carrillo C, Sadeghi N, Nicassio P, Ganz PA, et al. Tai Chi Chih compared with cognitive behavioral therapy for the treatment of insomnia in survivors of breast cancer: a randomized, partially blinded, noninferiority trial. *J Clin Oncol* 2017;35:2656-65.
  49. Garland SN, Johnson JA, Savard J, Gehrman P, Perlis M, Carlson L, et al. Sleeping well with cancer: a systematic review of cognitive behavioral therapy for insomnia in cancer patients. *Neuropsychiatr Dis Treat* 2014;10:1113-24.
  50. Johnson JA, Rash JA, Campbell TS, Savard J, Gehrman PR, Perlis M, et al. A systematic review and meta-analysis of randomized controlled trials of cognitive behavior therapy for insomnia (CBT-I) in cancer survivors. *Sleep Med Rev* 2016;27:20-8.
  51. Savard J, Villa J, Simard S, Ivers H, Morin CM. Feasibility of a self-help treatment for insomnia comorbid with cancer. *Psychooncology* 2011; 20:1013-9.
  52. Savard J, Simard S, Ivers H, Morin CM. Randomized study on the efficacy of cognitive-behavioral therapy for insomnia secondary to breast cancer, part I: Sleep and psychological effects. *J Clin Oncol* 2005;23: 6083-96.
  53. Savard J, Ivers H, Savard MH, Morin CM. Is a video-based cognitive behavioral therapy for insomnia as efficacious as a professionally administered treatment in breast cancer? Results of a randomized controlled trial. *Sleep* 2014;37:1305-14.
  54. Savard J, Simard S, Giguère I, Ivers H, Morin CM, Maunsell E, et al. Randomized clinical trial on cognitive therapy for depression in women with metastatic breast cancer: psychological and immunological effects. *Palliat Support Care* 2006;4:219-37.
  55. Ong JC, Kuo TF, Manber R. Who is at risk for dropout from group cognitive-behavior therapy for insomnia? *J Psychosom Res* 2008;64: 419-25.
  56. Spielman AJ, Saskin P, Thorpy MJ. Treatment of chronic insomnia by restriction of time in bed. *Sleep* 1987;10:45-56.
  57. Carney CE, Buysse DJ, Ancoli-Israel S, Edinger JD, Krystal AD, Lichstein KL, et al. The consensus sleep diary: standardizing prospective sleep self-monitoring. *Sleep* 2012;35:287-302.
  58. Mock V, Abernathy A, Atkinson A, Barsevick A, Berger A, Cella D. NCCN Clinical Practice Guidelines in Oncology™. In: Cancer-related fatigue. Washington: National Comprehensive Cancer Network 2015.
  59. Cella D, Davis K, Breitbart W, Curt G; Fatigue Coalition. Cancer-related fatigue: prevalence of proposed diagnostic criteria in a United States sample of cancer survivors. *J Clin Oncol* 2001;19:3385-91.
  60. Lichstein KL. Sleep compression treatment of an insomnioid. *Behavior Therapy* 1988;19:625-32.
  61. Berger AM, Kuhn BR, Farr LA, Lynch JC, Agrawal S, Chamberlain J, et al. Behavioral therapy intervention trial to improve sleep quality and cancer-related fatigue. *Psychooncology* 2009;18:634-46.
  62. Kangas M, Bovbjerg DH, Montgomery GH. Cancer-related fatigue: a systematic and meta-analytic review of non-pharmacological therapies for cancer patients. *Psychol Bull* 2008;134:700-41.
  63. Bootzin RR. Stimulus control treatment for insomnia. In: American psychological association. *APA 80th Annual Convention*. Honolulu: American Psychological Association 1972;1973.
  64. Bootzin RR, Epstein D, Wood JM. Stimulus control instructions. In: Hauri PJ. *Case studies in insomnia*. Boston: Springer 1991;19-28.
  65. Puder R, Lacks P, Bertelson AD, Storandt M. Short-term stimulus control treatment of insomnia in older adults. *Behavior Therapy* 1983;14: 424-9.
  66. Ancoli-Israel S, Moore PJ, Jones V. The relationship between fatigue and sleep in cancer patients: a review. *Eur J Cancer Care (Engl)* 2001;10: 245-55.
  67. Beck AT. *Cognitive therapy of depression*. 2nd ed. New York: Guilford Press 1979.
  68. Beck A, Emery G, Greenberg R. *Anxiety disorders and phobias: a cognitive perspective*. New York: Basic Books 2005.
  69. Morin CM, Vallières A, Ivers H. Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep* 2007; 30:1547-54.
  70. Harvey KJ, Espie CA. Development and preliminary validation of the Glasgow Content of Thoughts Inventory (GCTI): a new measure for the assessment of pre-sleep cognitive activity. *Br J Clin Psychol* 2004; 43:409-20.
  71. Chung S, Youn S, Choi B. Assessment of cancer-related dysfunctional beliefs about sleep for evaluating sleep disturbance in cancer patients. *Sleep Med Res* 2017 Nov 3 [Epub ahead of print]. <https://doi.org/10.17241/smr.2017.00073>.
  72. Carrillo-Vico A, Lardone PJ, Alvarez-Sánchez N, Rodríguez-Rodríguez A, Guerrero JM. Melatonin: buffering the immune system. *Int J Mol Sci* 2013;14:8638-83.
  73. Lewy AJ. The dim light melatonin onset, melatonin assays and biological rhythm research in humans. *Biol Signals Recept* 1999;8:79-83.
  74. Jiao L, Duan Z, Sangi-Haghpeykar H, Hale L, White DL, El-Serag HB. Sleep duration and incidence of colorectal cancer in postmenopausal women. *Br J Cancer* 2013;108:213-21.
  75. Trudel-Fitzgerald C, Zhou ES, Poole EM, Zhang X, Michels KB, Eliassen AH, et al. Sleep and survival among women with breast cancer: 30 years of follow-up within the Nurses' Health Study. *Br J Cancer* 2017;116: 1239-46.
  76. Collins KP, Geller DA, Antoni M, Donnell DM, Tsung A, Marsh JW, et al. Sleep duration is associated with survival in advanced cancer patients. *Sleep Med* 2017;32:208-12.
  77. Reiche EM, Nunes SO, Morimoto HK. Stress, depression, the immune system, and cancer. *Lancet Oncol* 2004;5:617-25.
  78. Dettenborn L, James GD, Valdimarsdottir HB, Montgomery GH, Bovbjerg DH. Breast cancer-specific intrusions are associated with increased cortisol responses to daily life stressors in healthy women without personal or family histories of breast cancer. *J Behav Med* 2006; 29:477-85.
  79. Hauri P. *The sleep disorders (Current concepts)*. 2nd ed. Kalamazoo: Upjohn 1982;2-16.
  80. Stepanski EJ, Wyatt JK. Use of sleep hygiene in the treatment of insomnia. *Sleep Med Rev* 2003;7:215-25.
  81. Irish LA, Kline CE, Gunn HE, Buysse DJ, Hall MH. The role of sleep hygiene in promoting public health: A review of empirical evidence. *Sleep Med Rev* 2015;22:23-36.
  82. Mastin DF, Bryson J, Corwyn R. Assessment of sleep hygiene using the Sleep Hygiene Index. *J Behav Med* 2006;29:223-7.
  83. Simeit R, Deck R, Conta-Marx B. Sleep management training for cancer patients with insomnia. *Support Care Cancer* 2004;12:176-83.
  84. Zupanec S, Jones H, McRae L, Papaconstantinou E, Weston J, Stremmler R. A Sleep hygiene and relaxation intervention for children with acute lymphoblastic leukemia: a pilot randomized controlled trial. *Cancer Nurs* 2017;40:488-96.
  85. Walker AJ, Johnson KP, Miaskowski C, Lee KA, Gedaly-Duff V. Sleep quality and sleep hygiene behaviors of adolescents during chemotherapy. *J Clin Sleep Med* 2010;6:439-44.
  86. Youn S, Hann C-WC, Park B, Lee S, Kim C, Yi K, et al. The sleeping pill prescription rate for inpatients at a general hospital. *Sleep Medicine Research* 2016;7:33-8.
  87. Haynes PL, Bootzin RR. Insomnia treatments: moving from efficacy to effectiveness. *J Clin Psychol* 2010;66:1131-6.
  88. Borkovec TD, Fowles DC. Controlled investigation of the effects of progressive and hypnotic relaxation on insomnia. *J Abnorm Psychol* 1973; 82:153-8.
  89. Nicassio P, Bootzin R. A comparison of progressive relaxation and autogenic training as treatments for insomnia. *J Abnorm Psychol* 1974;83: 253-60.
  90. Kahn M, Baker BL, Weiss JM. Treatment of insomnia by relaxation

- training. *J Abnorm Psychol* 1968;73:556-8.
91. Woolfolk RL, McNulty TF. Relaxation treatment for insomnia: a component analysis. *J Consult Clin Psychol* 1983;51:495-503.
  92. Lacks P, Bertelson AD, Gans L, Kunkel J. The effectiveness of three behavioral treatments for different degrees of sleep onset insomnia. *Behavior Therapy* 1983;14:593-605.
  93. Cannici J, Malcolm R, Peek LA. Treatment of insomnia in cancer patients using muscle relaxation training. *J Behav Ther Exp Psychiatry* 1983;14:251-6.
  94. Demiralp M, Oflaz F, Komurcu S. Effects of relaxation training on sleep quality and fatigue in patients with breast cancer undergoing adjuvant chemotherapy. *J Clin Nurs* 2010;19:1073-83.
  95. Adamsen L, Stage M, Laursen J, Rørth M, Quist M. Exercise and relaxation intervention for patients with advanced lung cancer: a qualitative feasibility study. *Scand J Med Sci Sports* 2012;22:804-15.
  96. Ritterband LM, Bailey ET, Thorndike FP, Lord HR, Farrell-Carnahan L, Baum LD. Initial evaluation of an Internet intervention to improve the sleep of cancer survivors with insomnia. *Psychooncology* 2012;21:695-705.
  97. Zhou ES, Vrooman LM, Manley PE, Crabtree VM, Recklitis CJ. Adapted delivery of cognitive-behavioral treatment for insomnia in adolescent and young adult cancer survivors: a pilot study. *Behav Sleep Med* 2017;15:288-301.
  98. Morin CM, LeBlanc M, Daley M, Gregoire JP, Mérette C. Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep Med* 2006;7:123-30.
  99. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA Cancer J Clin* 2015;65:87-108.
  100. Davidson JR, Waisberg JL, Brundage MD, MacLean AW. Nonpharmacologic group treatment of insomnia: a preliminary study with cancer survivors. *Psychooncology* 2001;10:389-97.
  101. Quesnel C, Savard J, Simard S, Ivers H, Morin CM. Efficacy of cognitive-behavioral therapy for insomnia in women treated for nonmetastatic breast cancer. *J Consult Clin Psychol* 2003;71:189-200.
  102. Epstein DR, Dirksen SR. Randomized trial of a cognitive-behavioral intervention for insomnia in breast cancer survivors. *Oncol Nurs Forum* 2007;34:E51-9.
  103. Dirksen SR, Epstein DR. Efficacy of an insomnia intervention on fatigue, mood and quality of life in breast cancer survivors. *J Adv Nurs* 2008;61:664-75.
  104. Fiorentino L, McQuaid JR, Liu L, Natarajan L, He F, Cornejo M, et al. Individual cognitive behavioral therapy for insomnia in breast cancer survivors: a randomized controlled crossover pilot study. *Nat Sci Sleep* 2010;2:1-8.
  105. Garland SN, Carlson LE, Antle MC, Samuels C, Campbell T. I-CAN SLEEP: rationale and design of a non-inferiority RCT of mindfulness-based stress reduction and cognitive behavioral therapy for the treatment of insomnia in CANcer survivors. *Contemp Clin Trials* 2011;32:747-54.
  106. Fleming L, Randell K, Harvey CJ, Espie CA. Does cognitive behavioural therapy for insomnia reduce clinical levels of fatigue, anxiety and depression in cancer patients? *Psychooncology* 2014;23:679-84.
  107. Matthews EE, Berger AM, Schmiede SJ, Cook PF, McCarthy MS, Moore CM, et al. Cognitive behavioral therapy for insomnia outcomes in women after primary breast cancer treatment: a randomized, controlled trial. *Oncol Nurs Forum* 2014;41:241-53.
  108. Garland SN, Rouleau CR, Campbell T, Samuels C, Carlson LE. The comparative impact of mindfulness-based cancer recovery (MBCR) and cognitive behavior therapy for insomnia (CBT-I) on sleep and mindfulness in cancer patients. *Explore (NY)* 2015;11:445-54.
  109. Casault L, Savard J, Ivers H, Savard MH. A randomized-controlled trial of an early minimal cognitive-behavioural therapy for insomnia comorbid with cancer. *Behav Res Ther* 2015;67:45-54.
  110. Roscoe JA, Garland SN, Heckler CE, Perlis ML, Peoples AR, Shayne M, et al. Randomized placebo-controlled trial of cognitive behavioral therapy and armodafinil for insomnia after cancer treatment. *J Clin Oncol* 2015;33:165-71.
  111. Garland SN, Gehrman P, Barg FK, Xie SX, Mao JJ. CHOosing Options for Insomnia in Cancer Effectively (CHOICE): design of a patient centered comparative effectiveness trial of acupuncture and cognitive behavior therapy for insomnia. *Contemp Clin Trials* 2016;47:349-55.
  112. Heckler CE, Garland SN, Peoples AR, Perlis ML, Shayne M, Morrow GR, et al. Cognitive behavioral therapy for insomnia, but not armodafinil, improves fatigue in cancer survivors with insomnia: a randomized placebo-controlled trial. *Support Care Cancer* 2016;24:2059-66.
  113. Kamen C, Garland SN, Heckler CE, Peoples AR, Kleckner IR, Cole CL, et al. Social support, insomnia, and adherence to cognitive behavioral therapy for insomnia after cancer treatment. *Behav Sleep Med* 2017;1-13.
  114. Peoples AR, Garland SN, Perlis ML, Savard J, Heckler CE, Kamen CS, et al. Effects of cognitive behavioral therapy for insomnia and armodafinil on quality of life in cancer survivors: a randomized placebo-controlled trial. *J Cancer Surviv* 2017;11:401-9.
  115. Chung S, Youn S. The optimizing strategies for prescription of sleeping pills for insomnia patients. *Sleep Med Res* 2017;8:8-16.
  116. Chung S, Youn S, Yi K, Park B, Lee S. Sleeping pill administration time and patient subjective satisfaction. *J Clin Sleep Med* 2016;12:57-62.