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.

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.1 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.2,3 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.5-8 Given the known physical and psychological health consequences of insomnia,9-11 early identification and treatment of insomnia must be a clinical priority.12 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.3,13,14

DEVELOPMENT OF INSOMNIA IN CANCER PATIENTS

Spielman’s 3-P model is widely accepted for explaining the etiology and maintenance processes of chronic insomnia.15 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 disrup-
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). At the outset, a cancer diagnosis itself is a traumatic event that completely alters the course of the patient’s life and can precipitate insomnia. 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. 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. 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. In addition, relationship dysfunction between partners may become exacerbated following a cancer diagnosis, 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, which 58% reported that cancer aggravated existing sleep problems. 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.

**Table 1.** The 3-P model for insomnia among cancer patients

<table>
<thead>
<tr>
<th>Predisposing factors</th>
<th>Older age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female gender</td>
</tr>
<tr>
<td></td>
<td>Personal or family history of psychiatric disorder</td>
</tr>
<tr>
<td></td>
<td>Medical or psychiatric comorbidities</td>
</tr>
<tr>
<td></td>
<td>Hyperarousability trait</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Precipitating factors</th>
<th>Distress from cancer diagnosis and treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Psychiatric symptoms (depression, anxiety, delirium)</td>
</tr>
<tr>
<td></td>
<td>Cancer related symptoms (pain, fatigue, hot flashes)</td>
</tr>
<tr>
<td></td>
<td>Cancer treatment (chemotherapy, radiotherapy, hormonal therapy)</td>
</tr>
<tr>
<td></td>
<td>Certain medications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perpetuating factors</th>
<th>Surgery or hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime napping</td>
</tr>
<tr>
<td></td>
<td>Excessive time in bed</td>
</tr>
<tr>
<td></td>
<td>Irregular sleep-wake schedule</td>
</tr>
<tr>
<td></td>
<td>Sleep interfering activities (watching smartphone or TV in bed)</td>
</tr>
<tr>
<td></td>
<td>Unrealistic sleep expectations</td>
</tr>
<tr>
<td></td>
<td>Faulty sleep appraisals</td>
</tr>
<tr>
<td></td>
<td>Tendency to worry in bed</td>
</tr>
</tbody>
</table>

**INSOMNIA TREATMENT IN CANCER PATIENTS**

Despite known side effects, a goal of short-term use, and potential for interactions with cancer-directed therapies, 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. 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. 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.

**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. Currently, stimulus...
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.41

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.42 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.43-45 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.46-48 For a more comprehensive review, see Garland et al.49 and Johnson et al.50 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.44,51,52 Additionally, there has also been some evidence for improvements in fatigue and quality of life.44,52,53 There has also been one study by Savard et al.54 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 ongoing 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.55 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.56 The patient’s sleep outcomes are usually tracked using daily sleep diaries,57 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.58 The prevalence of cancer-related fatigue is high,59 thus it is essential to incorporate a discussion of how to address this in the context of sleep restriction for cancer patients. While suggesting 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>
<thead>
<tr>
<th>Author</th>
<th>Sample size</th>
<th>Type of cancer</th>
<th># of sessions</th>
<th>Format</th>
<th>Delivery mechanism</th>
<th>Drop-out rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davidson et al.</td>
<td>CBT-I = 12</td>
<td>Breast, lymphoma, cervix,</td>
<td>6</td>
<td>Group</td>
<td>CBT-I = face-to-face (4–6)</td>
<td>CBT-I = 14.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>melanoma</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Quesnel et al.</td>
<td>CBT-I = 10</td>
<td>Breast cancer</td>
<td>8</td>
<td>Group</td>
<td>CBT-I = face-to-face (session 1–8)</td>
<td>CBT-I = 20.00</td>
</tr>
<tr>
<td>Savard et al.</td>
<td>Full sample = 57, CBT-I = 27, WLC = 30</td>
<td>Breast cancer</td>
<td>8</td>
<td>Group (4–6)</td>
<td>CBT-I = face-to-face (session 1–8)</td>
<td>N/A</td>
</tr>
<tr>
<td>Epstein &amp; Dirksen</td>
<td>Full sample = 81, CBT-I = 40, sleep education = 41</td>
<td>Breast cancer</td>
<td>6</td>
<td>Group and individual</td>
<td>CBT-I = face-to-face (group session 1, 2, 3, 4), telephone (individual session 5, 6)</td>
<td>Total = 11.11 CBT-I = 15.00 Control group = 7.31</td>
</tr>
<tr>
<td>Dirksen &amp; Epstein</td>
<td>Full sample = 81, CBT-I = 40, component control = 41</td>
<td>Breast cancer</td>
<td>6</td>
<td>Group and individual</td>
<td>CBT-I = face-to-face (group session 1–6)</td>
<td>Total = 8.64  CBT-I = 10.00  CC = 7.31</td>
</tr>
<tr>
<td>Espie et al.</td>
<td>Full sample = 150, CBT-I = 100, TAU = 50</td>
<td>Breast, prostate, colorectal, gynecological cancer</td>
<td>5</td>
<td>Group (4–6)</td>
<td>CBT-I = face-to-face (session 1, 2, 3, 4, 5)</td>
<td>Total = 14.66  CBT-I = 15.00  Control group = 14.00</td>
</tr>
<tr>
<td>Fiorentino et al.</td>
<td>Full sample = 21, CBT-I = 11, control = 10</td>
<td>Breast cancer</td>
<td>6</td>
<td>Individual</td>
<td>CBT-I = face-to-face (session 1–6)</td>
<td>Total = 33.33  CBT-I = 45.45  Control group = 20.00</td>
</tr>
<tr>
<td>Garland et al.</td>
<td>Full sample = 110, CBT-I = 55, MBSR = 55</td>
<td>Cancer survivor (no restrictions on tumor location)</td>
<td>8</td>
<td>Group (6–10 individuals)</td>
<td>Face-to-face</td>
<td>N/A</td>
</tr>
<tr>
<td>Savard et al.</td>
<td>CBT-I = 11</td>
<td>Breast</td>
<td>N/A</td>
<td>Individual</td>
<td>Self-CBT-I: DVD and booklet</td>
<td>0</td>
</tr>
<tr>
<td>Matthews et al.</td>
<td>Full sample = 60, CBT-I = 30, BPT = 30</td>
<td>Breast cancer</td>
<td>6</td>
<td>Individual</td>
<td>Face-to-face (session 1–3, 6), phone (session 4, 5)</td>
<td>N/A</td>
</tr>
<tr>
<td>Ritterband et al.</td>
<td>Full sample = 28, internet CBT-I = 14, control = 14</td>
<td>Any cancer type (93% breast cancer)</td>
<td>6</td>
<td>Individual</td>
<td>Internet (session 1–6)</td>
<td>0</td>
</tr>
<tr>
<td>Savard et al.</td>
<td>Full sample = 242, PCBT-I = 81, VCBT-I = 80, control = 81</td>
<td>Breast cancer</td>
<td>PCBT-I = 6</td>
<td>Individual</td>
<td>PCBT-I = face-to-face (session 1–6), VCBT-I = video (session 1–6)</td>
<td>Total = 15.70 PCBT-I = 13.58 VCBT-I = 28.75 Control = 4.93</td>
</tr>
<tr>
<td>Fleming et al.</td>
<td>Full sample = 113, CBT-I = 73, TAU = 40</td>
<td>Breast, prostate, bowel, gynaecological</td>
<td>5</td>
<td>Group</td>
<td>Face-to-face</td>
<td>Total = 24.66  CBT-I = 27.00  TAU = 20.00</td>
</tr>
<tr>
<td>Author</td>
<td>Sample size</td>
<td>Type of cancer</td>
<td># of sessions</td>
<td>Format</td>
<td>Delivery mechanism</td>
<td>Drop-out rate (%)</td>
</tr>
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</tr>
<tr>
<td>Garland et al.46</td>
<td>CBT-I = 47</td>
<td>Breast cancer, prostate, blood/lymph, female genitourinary, colon/GI, head and neck, lung</td>
<td>8</td>
<td>Group (6-10)</td>
<td>Face-to-face</td>
<td>21.28</td>
</tr>
<tr>
<td>Matthews et al.107</td>
<td>Full sample = 60, CBT-I = 32, BPT = 28</td>
<td>Breast cancer</td>
<td>6</td>
<td>Individual</td>
<td>Face-to-face (session 1, 2, 3, 6), phone (session 4, 5)</td>
<td>Total = 6.66 CBT-I = 6.25 BPT = 7.14</td>
</tr>
<tr>
<td>Garland et al.108</td>
<td>Full sample = 72, MBCR = 32, CBT-I = 40</td>
<td>Breast cancer, prostate, blood/lymph, female genitourinary, lung, head and neck, colorectal</td>
<td>8</td>
<td>Group (6-10)</td>
<td>Face-to-face</td>
<td>N/A</td>
</tr>
<tr>
<td>Casault et al.109</td>
<td>Full sample = 38, self-help CBT-I = 20, control = 18</td>
<td>Breast, colorectal, other (lung, prostate, bowel, tongue, vulva)</td>
<td>6</td>
<td>Individual</td>
<td>Self-help CBT-I: booklets + phone</td>
<td>Self-help CBT-I = 15.00</td>
</tr>
<tr>
<td>Roscoe et al.110</td>
<td>Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24</td>
<td>Any cancer (breast cancer 68%)</td>
<td>7</td>
<td>Individual</td>
<td>Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)</td>
<td>Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16</td>
</tr>
<tr>
<td>Garland et al.111</td>
<td>Full sample = 160, CBT-I = 65, acupuncture = 65</td>
<td>Any cancer type</td>
<td>7</td>
<td>Individual</td>
<td>Face-to-face</td>
<td>N/A</td>
</tr>
<tr>
<td>Garland et al.47</td>
<td>Full sample = 88, CBT-I + placebo = 21, CBT-I + armodafinil = 22, placebo = 23, armodafinil = 22</td>
<td>Any cancer type (68% breast cancer)</td>
<td>7</td>
<td>Individual</td>
<td>Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)</td>
<td>17.04% for total sample</td>
</tr>
<tr>
<td>Heckler et al.112</td>
<td>Full sample = 96, CBT-I + placebo = 24, CBT-I + armodafinil = 23, placebo = 25, armodafinil = 24</td>
<td>Any cancer type (68% breast cancer)</td>
<td>7</td>
<td>Individual</td>
<td>Face-to-face (session 1, 2, 4), phone (session 3, 5, 6, 7)</td>
<td>Total = 23.95 CBT-I + placebo = 20.83 CBT-I + armodafinil = 21.73 Placebo = 24.00 Armodafinil = 29.16</td>
</tr>
<tr>
<td>Irwin et al.48</td>
<td>Full sample = 90, CBT-I = 45, TCC = 45</td>
<td>Breast cancer</td>
<td>12</td>
<td>Group (7–10)</td>
<td>Face-to-face (session 1–12)</td>
<td>CBT-I = 56.30 TCC = 53.30</td>
</tr>
</tbody>
</table>
Cognitive Therapy

The cognitive therapy component of CBT-I applies traditional techniques of cognitive therapy developed by Beck and others, and is essential to success. The establishment of a partner, family member, or friend's support can be critical when patients are unable to sleep and must remain out of their bed or from their sleep environment. The goal of the cognitive therapy component of CBT-I is to help patients identify and challenge their maladaptive thoughts, beliefs, and behaviors that maintain their insomnia. This includes helping patients to recognize and modify their irrational beliefs and cognitive distortions, such as the belief that thoughts about sleep will interfere with sleep, that not being able to fall asleep quickly means they will not be able to fall asleep at all, or that being awake during nighttime sleep means they will not be able to get any sleep at all. Patients are also taught to develop more realistic and helpful thoughts about sleep, such as recognizing that being awake for a short period of time during the night is normal and does not necessarily mean they will not be able to fall asleep or stay asleep. This is done through the use of cognitive restructuring techniques, which involve identifying and changing negative thoughts and replacing them with more positive and realistic ones.

Stimulus Control

Stimulus control is the process of changing the environment in which patients sleep to make it less conducive to sleep. This involves teaching patients to associate their bed and bedroom with sleep, rather than other activities such as napping, reading, or watching television. Patients are also taught to keep their bedroom environment quiet, dark, and comfortable, and to maintain a regular sleep schedule. This can be achieved through the use of sleep hygiene techniques, such as keeping the bedroom dark and quiet, avoiding naps during the day, and going to bed only when they are sleepy. Patients are also taught to avoid cognitive activities in bed, such as reading or using electronic devices, which can interfere with sleep. Instead, they are encouraged to engage in relaxing activities, such as meditation or deep breathing exercises, which can help calm the mind and promote relaxation. This can be done through the use of guided imagery techniques, which involve focusing on positive images and sensations to help reduce anxiety and promote relaxation. The goal of stimulus control is to create a sleep-conducive environment in which patients can sleep better and more consistently. This can be achieved through the use of behavioral interventions, such as sleep restriction or sleep compression, which involve limiting the time spent in bed and in bed-related activities. This can be done through the use of a sleep diary, which tracks the amount of time spent in bed and the duration of sleep, and helps patients to identify patterns of sleep that are not conducive to sleep. By identifying these patterns, patients can develop strategies to change their sleep environment and improve their sleep. This can be done through the use of a sleep plan, which outlines specific actions that patients can take to improve their sleep, such as avoiding caffeine and alcohol, maintaining a regular sleep schedule, and creating a sleep-conducive environment in their bedroom.
To some degree, these concerns may have some merit. If I do not sleep well at night, my cancer may recur or metastasis a certain time will have a serious effect on my immune system or that cancer patients may report, such as ‘Not going to sleep at a certain time’ or ‘Worried about what will happen if I don’t sleep’. Some therapists use a daily mood log that patients can use in-session and for homework that identifies specific situations related with sleep, automatic thoughts, and emotions associated with these consequences of poor sleep. Worrying about sleep duration 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.

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. 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.

The American Academy of Sleep Medicine recommends sleep hygiene education as a part of treatment of insomnia, 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. 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. There have been several studies which have explored the effectiveness of sleep hygiene in insomnia.

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### Table 3. Sleep indices to explore individual’s sleep structure

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

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among cancer patients as a single modality, and most studies combined sleep hygiene with relaxation training or other modalities. 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. These sleep hygiene issues may develop during an inpatient hospitalization, especially if patients must share a room with others. 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.

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. It does not appear to be as effective as other components of CBT-I (e.g., stimulus control) by itself, but does promote improved sleep. There is evidence to suggest that relaxation therapy can be a helpful intervention among cancer populations, with a possible secondary benefit of also improving fatigue. 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. 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. 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. However, major challenges remain with respect to adequate screening for insomnia in cancer programs. In combination with the low likelihood that a patient with insomnia will seek professional treatment, 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 symptoms, 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, 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.

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