# Adherence to cognitive behaviour therapy for insomnia- an updated systematic review

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**Key points:**

1) Adherence to Cognitive Behaviour Therapy to insomnia (CBT-I) is complex and requires clear definitions

2) The literature on adherence to CBT-I is heterogeneous and we need to work towards a consensus on how to measure and operationalise adherence.

Synopsis (100 words or less)

In this systematic review we extracted information from 53 studies that have measured adherence to Cognitive Behaviour Therapy for insomnia (CBT-I). There has been an increase in more complex and less biased methods for assessing adherence that move beyond simply asking the patient whether they have adhered to the intervention or not. This demonstrates the need for a consensus around how to measure adherence, if we want to derive at an estimate of "optimal adherence".

Heterogeneity of studies, particularly in the way adherence is operationalised, prohibited conclusions about the relationship between adherence and outcome as well as predictors of adherence to be drawn.

## Introduction

The current treatment of choice for chronic insomnia is cognitive behavioural therapy for insomnia (CBT-I), a multi-component intervention typically involving strategies such as cognitive restructuring, sleep restriction, stimulus control, sleep hygiene education and relaxation therapy[1,2]. CBT-I is effective in reducing insomnia symptoms, improving self-reported sleep onset latency (SOL) and reducing wakefulness after sleep onset (WASO), with improvements still present at post-intervention follow-ups[3,4]. While CBT-I has considerable empirical support, it often requires behavioural and lifestyle changes that are intrusive and may be difficult to implement. Sleep restriction for example involves reducing time spent in bed to a therapist prescribed sleep window, in order to increase 'sleep efficiency' (the proportion of time in bed spent sleeping)[5]. Patients reportedly struggle to implement sleep restriction therapy due to the initial reduction in sleep opportunity leading to temporary sleep deprivation, increased daytime sleepiness and impaired daytime functioning[5,6]. Adherence may be particularly difficult when insomnia treatment involves lifestyle changes that require modification of habit, which in the case of insomnia can often be long-standing.

Patient adherence is important for establishing which aspects of therapy are particularly effective. The term "adherence" (versus the outdated term "compliance") acknowledges the patient's ability to decide whether to follow recommendations, and thus typically encapsulates the patient's behaviour as well as their beliefs, attitudes and motivations[7]. Conceptualising something like adherence to medication is relatively simple, the question is whether the patient has taken the medication or not. Adherence to CBT-I is more complex, since it is a multi-component intervention, the "dose" of therapy is ill defined so optimal levels of adherence cannot be determined, and there are variations in the way that treatment is delivered (different combinations of components for example). Consequently, it is not clear which elements of the intervention are the mechanistic drivers of improvement, and which factors predict non-adherence. In a 2013 systematic review of adherence to CBT-I[8] identified considerable heterogeneity in the way adherence to CBT-I was

operationalised and measured. The current literature review therefore aims to understand whether clinical trials involving CBT-I published since Matthews et al.'s review in 2013 have 1) measured adherence and whether this has been more homogeneous 2) reported any relationship between adherence and CBT-I outcomes 3) identified any consistent factors influencing adherence to CBT-I.

# Methods

**Searches:**

A systematic literature search was carried out with the assistance of a trained social sciences librarian. Searches were carried out in November 2019, in the databases PsychInfo, MEDLINE and Scopus. Pubmed was not used as a search engine, based on advice by the librarian, since it is similar to MEDLINE and might have generated a number of duplicates. In PsychInfo and Scopus, full texts were searched for combinations of: ("cognitive behavio* therap*" or "sleep restriction" or "sleep hygiene" or "stimulus control" or "sleep education" or relaxation or "cognitive therap*"), ("sleep disorder*" or insomnia), and (adherence or compliance or nonadherence or noncompliance or attrition). Searches were filtered to include only journal articles including human samples, written in English or German. The search in Medline database included the same search terms as keywords and relevant subject headings. Searches were limited to papers published from May 2012 onwards, as the most recent systematic review in this area[8] was conducted until this point. The search terms and criteria used in the Matthews et al.'s review were used for this review. References of papers were reviewed to determine any papers that were missed in the literature searches. Papers that were published since the end of our literature search were reviewed and included where appropriate.

**Inclusion/exclusion criteria**

Studies that met the following criteria were included within the review: a) peer-reviewed papers b) written in English or German c) measured adherence, meaning implementing behaviour change (not simply attrition or session attendance/engagement with the digital intervention) d) assessed a CBT-I intervention e) adult participants with insomnia (either characterised as sleep difficulties or measured via clinical assessment). The following exclusion criteria were used: a) paediatric or adolescent samples b) or having only measured participant attendance or attrition/engagement in the digital intervention and c) qualitative papers, editorials, single case studies and literature reviews.

**Screening procedures**

Search results were uploaded to the screening platform Covidence (https://www.covidence.org/), which is an online platform provided by the Cochrane Community, to facilitate systematic reviews. Titles and abstracts were screened by two reviewers (MC or SA and either MK, AH or SM who were blind to each other's decisions), and conflicts were resolved by a third reviewer. The full texts of the articles included at this stage were then screened by two independent reviewers (MC and then either SA, MK, AH or SM), with conflicts resolved by a third author to determine which papers should be included in the final review.

**Quality assessment**

Studies were assessed for quality of adherence data by considering the description of measures and whether the data was self-reported, quasi-objective or objective. For the purpose of the current review, adherence measures were classified as subjective, quasi-objective and objective. Self-report questionnaires (validated or not) were included in the subjective category. Any measure of adherence that was not directly assessed (e.g. did you adhere to your bedtime), but derived from reports of behaviour on the sleep diary (i.e., what time did you go to bed) was classified as quasi-objective. Such an indirect (quasi-objective) assessment of adherence would be less likely to be influenced by social desirability. If the spouse or therapist rated the patient's level of treatment implementation, then adherence was classified as objective, since it did not derive from the patients themselves. The description of adherence measure was rated as 'high' or 'low' based on the clarity of the method of measurement and calculation of magnitude. Self-reported data was given a quality rating of 'low', whereas quasi-objective or objective data were rated as 'high'. The reason for this is we believe that the patient reporting whether they were adherent may be influenced by social desirability (wanting to report that they followed the recommendations of their therapist). We do acknowledge however, that objective measures (such as the therapist-ratings we have considered here) are also amenable to certain biases. Furthermore, even measures such as actigraphy, which some might consider gold-standard for measuring adherence, relies on the participant pressing an event marker or accurately completing a sleep diary, and therefore might also not be an error-free measure of behaviour. Quality ratings were made by two reviewers (MC and then either SA, MK, AH or SM) and conflicts were discussed between the two reviewers.

**Data extraction**

The following data were extracted from the included studies: definition of insomnia, comorbidities, the type of intervention implemented (including CBT-I components, whether this was delivered face-to-face or online, individual or group format, whether the treatment was combined with another CBT-I intervention, length of sessions and duration of CBT-I). Data was also collected about study setting, participant demographics, measurement and magnitude of adherence, relationship between adherence and outcome (e.g. a correlation coefficient), and potential predictors or non-predictors of adherence. Data extraction was carried out by two independent reviewers (MC and then either SA, MN, AH or SM) and conflicts were resolved by MC.

# Results

*Search results*

Database searches identified 1,901 articles, two of which were included in Matthews et al. review[8]. 167 duplicates were removed; a further 1,579 were deemed irrelevant at the title and abstract screening stage. The most frequent reasons for exclusion at this stage were a non-insomnia sample, no CBT-I intervention and non-primary research. Full text screening excluded 155 papers. Reasons for exclusions are outlined in figure 1. Twelve papers from Matthews et al.'s review that were published prior to 2013 were added at the full text review/extraction stage. Three studies that were included in Matthews et al.'s review were not added to ours. Two papers did not include a sample of individuals suffering from insomnia, and one study examined use of CBT-I components long-term (as opposed to adherence). One study was added after reviewing reference lists of included studies. 53 studies were included for data extraction.

[insert figure 1here]

*Sample characteristics*

Table 1 summarises the 53 studies included in the final review.

(insert table 1 here with the characteristics)

Sample sizes in the included studies showed a wide variety, with a range from 6-696 participants. The majority of studies were from adult samples, with ages ranging from 18 to 95 years. Female only samples were recruited by four studies[9-12] and these were studies on female cancer patients or survivors. Three studies recruited male samples[13-15], two samples of veterans and one prison sample. Of 45 studies which included mixed male/female samples, the percentage of female participants ranged from 5-94%. Overall, the majority of studies recruited mainly female participants. In sixteen studies individuals with insomnia and a comorbid condition were recruited; in eight the comorbid condition was cancer[9-12,16-19]. Other comorbidities included depression[20], bipolar disorder[21], alcohol dependency[13], cardiac rehabilitation[22], war veterans with blast exposure/head injury[23], HIV[24], chronic migraine[25] and COPD[26]. The majority of studies defined presence of insomnia by using diagnostic criteria (e.g., DSM-IV[27], ICSD[28], or research diagnostic criteria[29]). Screening questionnaires included the Insomnia Severity Index [11,30-32], or the Pittsburgh Sleep Quality Index [9,16,26]. A number of studies set a minimum SOL and WASO score[12,18,33-35] in addition to daytime dysfunction/impairment[21,23,24,36-43]. Some studies required only a subjective complaint of insomnia or sleep problems[44,45].

*Intervention characteristics*

There was a variety of combinations of treatment components. Two studies focused on progressive muscle relaxation[26,45], or focused on breathing and visualisation[16]. Several studies evaluated cognitive and behavioural CBT-I components separately and as a combined intervention[42,46]. Three studies focused on sleep restriction as a standalone treatment[34,43,47]. One study evaluated stimulus control and sleep restriction separately, and as a combined intervention[37]. In several studies only behavioural components were delivered[24,25,30,35,39,48] . Additional interventions that were implemented alongside CBT-I were mindfulness meditation[48], Armodafinil[18,19], Modafinil[49], cardiac relevant information[22], one session of mindfulness[50], reminders to improve adherence[45], and CBT-I coach mobile app[51].

The majority of studies focused on individual, face-to-face interventions; nine studies evaluated group CBT-I, and ten evaluated digital CBT-I interventions. One study implemented a combination of group and individual sessions[52]. Several studies included both face-to-face and digital treatment arms[11,51], one study included separate telehealth and digital interventions[50], and one comprised of an individual, group and telephone treatment arm[33]. Of the ten studies using digital interventions, only four included therapist support[11,20,36,53]. Some studies used a combination of face-to-face and telephone sessions[10,18,19,24,47], and some combined group and telephone sessions[23,35,37]. Mean session duration ranged from 15 minutes (by telephone[23]) to 120 minutes[48], but most fell between 60-90 minutes. Most interventions were delivered in 6-8 sessions; however, several studies delivered CBT-I in a single dose [15,30,32,54,55].

*Measurement and magnitude of adherence*

For the purpose of the current review, adherence measures were classified as subjective, quasi-objective and objective (see description above) Figure 2 shows the number of studies included in our review over time (including those reviewed by Matthews et al. and depicted by type of adherence measure.

[insert figure 2 here]

Subjective adherence

Subjective adherence included measures where participants were directly asked if they had been adherent to the treatment recommendations.  In instances where adherence was conceptualised as

the percentage of participants who were considered adherent (based on cut-offs using either an arbitrary time-frame, or a Likert scale), these rates ranged from 10%[56] to 100%[11,50]. There was no consistency in the definition of the cut-offs for optimal adherence. Adherence to individual CBT-I components (including stimulus control, sleep restriction, cognitive therapy, sleep hygiene, and relaxation) were measured. With large variability across individual studies, a clear pattern did not emerge. Self-reported adherence rates to sleep hygiene however was at the higher end of the spectrum varying between 76%[41] and 100%[11,50] participants adherent. Adherence to relaxation techniques such as guided imagery, breathing exercises were lower with most adherence rates below 70%[23,39,41,50,56,57]. Adherence to sleep restriction, stimulus control and cognitive therapy were extremely variable, with % rates of participants deemed adherent in the 30s and 40s[31,50,57], in the 60s[31,41], or in the 80s and 90s[11,37,50,57].

In studies where the adherence was measured on a scale depicting the degree to which participants followed the recommendation, the adherence rates were relatively high. We transposed the average adherence scores from each study as if it had been a 0-100 % scale, so that we could compare scores across studies. The rates ranged from 56% to 86%[21,24,25,40,43,47,58]. Others reported percentage of time treatment was adhered to (median of 65%[17]) or days per week the participants were adherent to, which was quite variable (from median 0-1 days[45] to mean 6.23 days[59]). Sidani et al.[60] presented data detailing how many days participants used the bed for sleep alone (6.1-6.5 days), got out of bed if unable to sleep (1.3-2 days), and took nap in bed only if necessary (0.4-1 days). Importantly, they also reported days where the techniques were not applicable (e.g., participant slept through and therefore did not have to get up if unable to sleep). This is an important aspect of understanding adherence to CBT-I since some components are not always applicable, especially if the patient's sleep starts to improve. Ruiter Petrov and colleagues reported that participants described adhering to 77% of stimulus control instructions and 85% of sleep restriction instructions[30]. Others reported that participants spent on average 6 hours each week following the treatment methods [treatment components were not specified][53]. Seyedi Chengeni and colleagues found that participants spent 50 minutes completing relaxation practice, and did this on average 1.8 days per week[26].

[insert table 2 here with subjective measures]

Quasi-objective adherence

Quasi-objective measures related to instances where the assessment of adherence behaviour was indirect (e.g., asking them when they went to bed, and comparing this to the clinician-prescribed bedtime). This is particularly relevant for adherence to Sleep Restriction Therapy (SRT). In SRT, the patient's time in bed is curtailed to their average total sleep time assessed by sleep diaries (sometimes +15 to 30 minutes). Adherence to SRT can be derived by comparing the prescribed time in bed to the actual time in bed reported on the sleep diary or from examining the bedtime and rise time reports. In a number of studies (n=9), the percent of participants within a certain period of their prescribed TIB (e.g., within 15 minutes) was reported. Adherence was conceptualised either as time in bed that was identical to or within or 1 min[14], within 15 minutes[13,34,52,55] or within 30-60 minutes of their prescribed time in bed each night[14,18,19,34,55,56]. The proportion of participants who were within 15 minutes of their prescribed time in bed ranged from 36%[34]-91.7%[54]. Using a more generous cut-off of 30 minutes, the rates increased marginally to 37.5%[19]-100%[14]. The strictest cut-off for adherence was a TIB that was no more than 1 min greater than the prescribed TIB[14] and 57% of participants displayed this level of adherence on their sleep diary. Applying similar criteria (within 15 minutes) for bedtime, Perlis and colleagues reported 51% of participants were adherent to their prescribed bedtime; adding modafinil this increased to 80% of participants[49]. Ruiter Petrov and colleagues reported that 47% of participants were within 30 minutes of their prescribed rise time[30].

The second most frequently reported measure was days participants were adherent to their prescribed TIB/bedtime/rise time (e.g., within 15 minutes). The average percent of days participants' TIB was within 30 minutes was calculated and this was between 60% of days[10] and 83.2% of days[12]. Percent of days participants were with 15 minutes of their bedtime was relatively high. In three studies the reported percentages in the high 80s and low 90s[12,15,46]. Matthews reported slightly lower rates of 42.8-58.5 dependent on treatment week[10]. Participants were within 15 minutes of their rise time on 78.4-90% of days[12,15], within 30 minutes on 72.6-87.1 % of days[10,46] and within 60 minutes on 72.4 % of days[48].

In two studies the deviation from prescribed TIB was reported between 20-28 minutes[34,48]. For rise time, the deviation was similar[48,61], except in Ruiter Petrov et al.'s study where the deviation was on average 82 minutes[30]. For deviation from bedtime, Taylor and colleagues reported that participants were 8 minutes off their prescribed time[61].

In a number of studies it was reported whether the TIB was significantly different from the prescribed TIB as a measure of adherence. No significant differences between average actual and prescribed time in bed were reported in two studies[38,39]. Some measured adherence as reduction of

time in bed from pre to post-treatment and they reported reductions of 122[47] and 98[43] minutes. These indicated a significant change from pre-treatment values. McCrae did not report the mean differences, from pre to post treatment, but did report that changes were significant during the treatment phase, but not at follow-up[39].

In 2001, Riedel and Lichstein published a paper in which they conceptualised adherence as the variance of time in bed or rise time and they reported this variance was a strong predictor of treatment outcome[34]. This indicated that it was not the reduction in TIB, but the consistency of patients' sleep behaviours that led to improved outcomes. Several studies attempted to replicate their findings and also computed the standard deviation or the variance of either time in bed[14,32,34], bed time[62,63], rise time/wake time[14,32,34,40,62,63]. None of the studies clearly state how exactly variance was calculated, but the standard deviation is the square root of the variance. For the rates below, we converted the variance reported in the studies to minutes and then to the SD so the values are more easily interpretable by the reader. Ludwin et al. reported a median variance for TIB reduced from 2209 to 1225 at post treatment[14]. (This is equivalent to a reduction in the standard deviation [SD] from 47 minutes to 35 minutes). Riedel and Lichstein reported slightly higher mean levels of overall variance, but still a reduction at post treatment (from 4095 to 1189)[34]. (This is an equivalent to a reduction in the SD from 64 minutes to 34 minutes). When examining rise time variance, Ludwin et al. reported a reduction from 1521 to 761 at post treatment[14]. This is an equivalent of a reduction in SD from 39 minutes to 28 minutes). These rates were more comparable to those reported by Riedel and Lichstein (1790 to 692 or a change in SD of 42 to 26 minutes)[34]. Vincent reported variances in wake time of 4277 at baseline to 3249 at post treatment[40]. This is equivalent to a reduction in SD from 66 to 57 minutes). Cui et al. reported the standard deviations in wake time as 40.4 minutes and SDs in bedtime as 27 minutes [62]. Tamura and Tanaka reported the coefficient of variance (SD/mean) in bed and rise time[32]. We were unable to transform the coefficient of variance into the standard deviation in minutes with the information provided in the paper, so the coefficient of variance is reported here unchanged. The authors reported increased consistency in TIB and rise time at post treatment compared to baseline (2.6 to 2.3 for TIB and 8.9 to 7.3 for rise time)[32].

In some studies, an adherence measure was used that was not common with another study. This included 1) the mean proportion of time in bed reduction that was adhered and this was reported to be 68.99%[34] , and 2) scores ranging from 0-49 depicting adherence to individual components which was derived from the sleep diary, with scores varying from 42.4 to 45.6 depending on the treatment week[33]. The sleep diary was also used to determine adherence to components of stimulus control (no napping/reducing napping to no later than 3-3.15pm and shorter than 60 minutes and getting

out of bed if unable to sleep). Adherence to avoiding naps was reported on a mean of 95.6% of days[12] and 84.3 % of days[46]. Adherence to getting out of bed if awake at night was, on average, practiced on 97.73% of days[12], and 64.3% of days[46].

[insert table 3 here with quasi-objective measures]

Objective adherence data

Five studies measured adherence objectively using therapist ratings[42,46,51,63,64]. Although in three papers therapists were asked to rate adherence to individual intervention components[51,63,64], the magnitude of therapist-rated adherence was not reported.

In two studies[51,64] the Patient Adherence Form was utilised, which was created for the Veterans Affairs CBT-I Training Program[65]. Therapists rated participant adherence to six specific behaviours from 1-6 ('no adherence' to 'complete adherence'). This was then averaged to create an overall adherence score. In one paper[42] the Treatment Adherence Rating Scale-Therapist Report was used (derived from Lichstein, Riedel and Grieve[66], which asked to what extent participants completed practice exercises (from 0-100%, with 10% increments]). In two studies[46,63] original scales were created for therapists to rate the extent to which participants completed their homework. Ratings either ranged from 0-100[46] or 1-5[63] with higher values indicating better patient adherence. The magnitude of therapist-rated adherence to homework exercises Dong and colleagues reported was depicted in a mean score of 80.99[46]; Vincent and colleagues reported that therapists rated that 48% of participants were at least 'very much adherent'[63]. The same study also measured adherence by asking the spouse about patient adherence to different behaviours. The scores on this questionnaire ranged from 5-25, and on average spouses rated their partner's adherence as good (mean=20.58).

[insert table 4 here with objective measures]

Relationship between adherence and outcomes

*Subjective data*

There were conflicting findings regarding subjective adherence measures. While some found that self-reported[16,44] adherence was not related to treatment outcomes, in two studies self-reported frequency of using treatment components was significantly related to lower ISI scores post-

treatment, for overall CBT-I use (*r*=0.53[20]) and adherence specifically for cognitive *(r =−0.34*[58]) and behavioural components *(r*=−0.27[58]).

*Quasi-objective data*

The relationship between quasi-objective adherence and outcome was reported in eight studies, since there was a large variability in the way adherence was measured, clear patterns did not emerge. Matthews and colleagues reported a significant relationship between adherence to bedtime and reported awakenings at night (*r*=.35) and also total sleep time (*r*=.38)[10]. This was not replicated in other studies[22,46]. Similarly, adherence to rise time was not reported to be associated with outcome[46] and neither was adherence to TIB[14,46].

The first study to operationalise adherence as consistency in TIB/bedtime/rise time was by Riedel and Lichstein[34]. They reported that rise time variance was associated with improvements in sleep quality (r=-0.60) and nocturnal awakenings (r=0.44). Variance in TIB was associated with sleep efficiency (*r*=-0.51) and WASO (r=0.51). These associations with outcome were replicated in some (consistent wake time was related to tapering of sleep medication at post treatment, *r*= –.49[63]), but not other other studies[14,40]. However, it is important to note that some of these studies used variance of wake time. The use of wake time as opposed to rise time variance could be challenging, considering as the former is a measure of sleep/wake state and behaviour, rather than just behaviour.

Adherence to the quarter-hour-rule (getting up at night if unable to sleep), was associated with ISI change at post treatment (Beta -0.22), and follow-up (Beta -0.20), as well as with insomnia remission at post treatment (OR 2.63) and follow-up (OR 2.23)[46]. No napping during the day was associated with adherence and objective WASO (Beta=0.41), TST (0.41) and SE (0.38) in one study[12], but not in another[46].

*Objective data*

Therapist-ratings patient adherence were significantly related to higher ISI score reduction[46,64] and post-treatment insomnia remission[46]. Therapist ratings of how adherent participants were also related to outcomes including reduction in dysfunctional beliefs, less sleep related impairment, and better sleep quality, although not related to post-treatment SOL or sleep efficiency[63]. Spouse-rated adherence was not related to outcome[63]. Important to note here is that Vincent and Hameed[63] collected therapist ratings at the end of treatment, whereas Dong et al. and Trockel et al. asked therapists to rate adherence within each session[46,64].

Predictors of adherence

*Demographics*

Younger age was identified as a predictor of wake time variability in one study[40], but not in another[10]; older age was a predictor of bedtime and rise time variability[62], although another study did not find a significant relationship between age and adherence[48]. Post-secondary education and employment status was not related to self-reported adherence[16,40]. Having a bed partner or pet was positively related to adherence to stimulus control[30]. Gender was consistently not a predictor of adherence across self-reported[16,40] and quasi-objective[40,48,62] measures.

*Baseline insomnia variables*

Duration of insomnia[46] at baseline was not associated with adherence. Likewise, insomnia severity was unrelated to adherence[10,45,62] in several studies, although one study[48] reported that insomnia severity was negatively related to rise time adherence. Lower levels of fatigue was significantly related to adherence to rise time[10] and an overall measure of seven sleep diary behaviours[46]. However, daytime impairment was not found to be a significant predictor of behaviours reported in sleep diaries[46]. Lower levels of sleepiness predicted consistency of wake time[40]; however, this is not necessarily supportive of other studies, as wake time captures a behaviour and a sleep/wake state. Dysfunctional beliefs about sleep were negatively related to TIB and rise time adherence[48], although another study[46] found that dysfunctional beliefs about sleep and sleep-related safety behaviours were not significant predictors of bedtime, rise time or getting up at night when unable to sleep. Medication use at baseline was not related to spouse-rated adherence; however, tapering of sleep medication post treatment was related to higher therapist-rated adherence[63].

*Features of the intervention*

Adherence to relaxation was found to be higher in a telehealth than web-based intervention, although web-based treatment led to higher adherence in stimulus control, sleep restriction, cognitive therapy and sleep hygiene[50]. In contrast, treatment modality was not a significant predictor when comparing face-to-face therapy to a mobile application[51]. Relaxation adherence was also positively related to reminders, although the type of reminder (self or system-set) had no significant impact[45]. Recall of therapy components and the number of therapy components delivered

in a session were not related to self-reported homework adherence[21]. Adherence to prescribed TIB was significantly higher in an individual than group treatment arm[54]. Studies investigating the use of medication to combat sleepiness related to CBT-I (due to changes in sleep routine caused by sleep restriction and stimulus control) found mixed results: Modafinil was associated with prescribed bedtime adherence[49], while in another study[18] the use of Armodafinil was not associated with adherence (although this study used TIB as its adherence measure.)

*Health variables*

Health variables including perceived health, pain status, health status, exercise were not significant predictors of adherence[30], although less alcohol use was associated with better sleep hygiene adherence[30]. In samples with a cancer comorbidity, the number of health problems[62], months since cancer diagnosis and radiation were not significant predictors, although chemotherapy (compared to other treatments) was significantly related to TIB adherence[10].

*Mental health and sleep-related variables*

Low levels of depression were related to higher adherence to behavioural components of CBT-I (particularly rise time and reducing time in bed)[62,67]; however, psychiatric comorbidities were not identified as significant predictors of bedtime or rise time adherence[10,46,63]. No significant differences were found between high and low depression groups in adherence to cognitive components, with the exception of high depression participants reporting less change in expectations around sleep[58]. Conversely, another study found that depression and anxiety were not related to therapist-rated adherence, although no dysthymia was significantly positively related[63]. Sleep-related variables including more total wake time after the session and longer total sleep time were positively related to adherence[42].

*Psychological variables*

Several variables related to perception of treatment (suitability of the treatment, overall attitude towards and desire for continued treatment) were related to higher self-reported adherence[35]. However, treatment expectations at first session[46], perceived utility, therapist competence and interpersonal style, perceived benefits on insomnia/everyday functioning, satisfaction with format

and dose of treatment, satisfaction with outcomes and attribution of outcomes to treatment[35] were not predictors of adherence.

Perceived barriers were negatively related to self-reported adherence, but not a predictor of wake time consistency[40]. Perceived behavioural control did not predict self-reported overall adherence[40]; however, self-efficacy was related to sleep diary adherence measures relevant to sleep restriction and stimulus control[33]. Motivation[10] and social support[19] were predictors of adherence to prescribed TIB; motivation was also a predictor of rise time adherence[10]. Locus of control, behavioural intention, perceived opportunity and acceptance and use of technology did not significantly predict of adherence to relaxation exercises[45].

## Discussion

Despite the evidence for the efficacy of CBT-I as the first line treatment for chronic insomnia, our understanding of the patient's ability to implement individual recommendations is limited. The lack of reliable data regarding adherence to CBT-I limits knowledge of client engagement and the efficacy of specific intervention components. While the most recent systematic review in this area[10] identified a lack of papers investigating adherence, the current review demonstrates that recognition of the importance of measuring adherence to CBT-I is increasing. However, variation in study characteristics, definitions of adherence and a lack of standardised adherence measures remain a barrier to synthesis of adherence research as outlined in our review. Studies measuring CBT-I adherence vary greatly in sample size, modality, dosage, and intervention components. There is a need for more clinical trials to include a measure of adherence, so that we can determine how these differences in study characteristics affect the magnitude of adherence. For example, we do not know if components (like SRT) administered alone or in combination with other CBT-I components make adherence worse or better. Are less restricted sleep windows, as a result of negotiation between the therapist and the patient, associated with better adherence? If the patient opts to delay bedtime, advance rise time, versus cutting off time at both ends, does this have an impact on adherence? If cognitive components are delivered alongside (or even prior to) the behavioural components, will adherence to the behavioural components be increased? Measurement of adherence to specific CBT-I components has increased since the most recent review[10], so with continued focus on improving the way we measure adherence will hopefully result in answers to these questions.

**Our first recommendation is that clinical trials with CBT-I need to include a measure of adherence. There needs to be a focus on the individual components and we need to work toward a consensus of what constitutes optimal adherence to CBT-I.**

A number of studies since Matthew et al's review[10] have focused on assessing behaviour indirectly through the sleep diary (what we referred to here as quasi-objective) and have moved away from simply asking patients whether they were adherent or not. This is beneficial as these types of measures are less likely to be influenced by social desirability. The drawback of this development is a huge variability in the way adherence is measured, varying from n of participants meeting a specific cut-offs (within 15, 30 or 60 min of rise time/bedtime/TIB), n of days participants meet a specific cut-off, number of raw minutes deviation from bed time/rise time/TIB. This heterogeneity moves us further and further away from a sound understanding of the magnitude of non-adherence in CBT-I trials and makes it difficult to interpret the relationship between adherence and outcome. Therefore recommendations for optimal cut-offs cannot be made to guide clinicians in monitoring adherence to CBT-I. The most common cut-off used to determine adherence to prescribed TIB was 30 minutes deviation. This seems sensible, as it would theoretically translate to 15-minute deviation at bedtime and 15 minutes at rise time, which is also commonly reported. This is also consistent with the few studies, in which raw minute deviation was reported (22-28 min more time in bed than prescribed[34,48]. The cut off for bedtime was typically 15 minutes, but for rise time some used 15 minutes and some 30 minutes. A more generous cut-off for rise time is defendable under the consideration that it might be more difficult for individuals to rise in the morning, since they are going from a state of sleep to wake, which could be influenced by sleepiness/sleep inertia. In fact, these are effects that have not been considered as an influence on adherence to treatments for sleep disorders (for a detailed discussion of this issue see [68] and D'Rozario et al. in the current issue). We always consider non-adherence as intentional, but we know that sleepiness is powerful and can override our motivation to adhere to the recommendation. So a patient might be completely motivated to adhere to their get up time in the morning, but then when the behaviour is to be implemented (after a rapid transition from sleep to wake after the alarm goes off), the patient is driven by extreme sleepiness and is more likely to stay in bed, falls back asleep and therefore doesn't comply with the treatment recommendations. One could say a patient is adherent (is willing and motivated and has prepared for it by setting the alarm), but is not compliant (does not engage in the behaviour). Likewise, the individual might be prepared to adhere to stimulus control when discussing this recommendation with their therapist or their spouse during the day, but then when they are awake in the middle of the night, alone with their partner sleeping, and their decision making impaired (since the areas of the brain involved in decision making are less active than the

emotional areas of the brain during sleep), they might be less likely to get up. The state they are in where they make the decision to adhere (during the day), is different to the state in which they actually have to implement the behaviour. These kinds of issues have yet to be explored.

**Our second recommendation is to work towards to a consensus on how to measure adherence to SRT. This should be done by reporting a) raw minute deviations from TIB, bedtime and rise time, b) n of days participants were within 15 minutes of bedtime, 15 minutes within their TIB and 30 minutes within their rise time, and c) n of participants who on average were within 15 minutes of bedtime, 15 minutes within their TIB and 30 minutes within their rise time. If possible, we would encourage authors to report adherence to other cut-offs in supplementary material (e.g. 30 and 60 min of TIB), so we can establish what the optimal dose of adherence is.**

Since the publication by Riedel and Lichstein in 2001[34], the variance in TIB/bedtime/rise time was reported frequently. However, the heterogeneity in measures made it difficult to draw conclusions about the magnitude of variance in behaviour. Furthermore, many of the studies using this measure did not adequately describe the ways in which variance was calculated.

**Our third recommendation is to report variance of bedtime, TIB and rise time in minutes, with and include clear descriptions of how variance is calculated.**

The proportion of studies using objective measures of adherence has increased since Matthews' review[10]; however, it is important to note that objective here referred to therapist and spouse ratings. None of the studies examined adherence using objective measures such as actigraphy, (despite this method being tested in healthy subjects more than 15 years ago[69]), mattress sensors or camera technology. The lack of such objective measurements is likely a consequence of adherence mainly being a secondary outcome measure in most clinical trials.

**Our fourth recommendation is to explore objective measurement of adherence in clinical trials of CBT-I and to establish a gold-standard that is unaffected by bias.**

The heterogeneity across studies also meant that drawing conclusions about the relationship between adherence and outcome as well as predictors of adherence was challenging. This was further complicated by different definitions of outcomes and different predictors used. One important aspect to consider here is the importance of a temporal difference between measuring adherence and outcome in order to establish true causal relationships. It is also imperative to develop unbiased objective measures of adherence as described above. Therapists might rate their patients are more adherent if they are improving. Overall, only a few studies reported the relationship between adherence and outcome. It is important to establish this link, as if it emerges

that adherence is not related to outcome, we need to understand which aspects of treatment are mechanisms of change and what predicts adherence.

**Our fifth recommendation is to measure the relationship between adherence and outcome. Usually, the treatment is only as good as when it is correctly implemented, however this remains an assumption for CBT-I. Importantly, there needs to be a temporal difference between measuring adherence and treatment outcome, in order to establish causality. Studies examining adherence should also test for predictors (particularly those that are modifiable.**

One last observation to be made here is that very few studies with digital CBT-I measure adherence that goes beyond attrition, diary completion, or viewed/completed sessions. In fact, twenty studies (50%) of all studies that were excluded because of they did not include a measure of adherence included digital CBT-I. This is interesting since adherence should be easy to measure through electronic sleep diaries. Studies that include digital CBT-I should be including measures of adherence.

## Summary

In conclusion, the current review demonstrates that awareness of adherence and research into adherence to CBT-I has become more prevalent over the past decade. However, these studies show wide variation across sample sizes, comorbidities, treatment dosage, and importantly across adherence measures. We hope that researchers can adopt our recommendations, so that a consensus around the optimal measurement and magnitude of adherence can be reached in order to determine the association with treatment outcome and predictors. This could guide future adherence intervention studies as well as individual clinicians.

## Clinics Care Points

- Some studies indicate there is a small to moderate relationship between adherence to CBT-I and outcome (although this is contradicted by others). Since there is some evidence of a relationship, we would advise clinicians to monitor adherence and explore avenues to improve adherence.
- Adherence to CBT-I is complex, and patients who do not adhere often do so intentionally. However, there is also room to consider patient's unintentional non-adherence, particularly if their behaviour is influenced by sleepiness or sleep inertia (for example not being able to get up at their prescribed rise time because they are too sleepy).

- Patients might be selected when adhering to individual CBT-I components. Clinicians are thus advised to examine non-adherence to one component in the context of adherence to another component.

**Acknowledgments**

We would like to thank Sarah Kevill, librarian at the University of Strathclyde for her support during the literature searches.

Table 1: Study characteristics of reviewed studies

| Author, year | Sample | Intervention | Setting | Insomnia inclusion criteria |
|---|---|---|---|---|
| Absolon et al. (2016)[16] | N=28<br>Age=mean 54.14 years(SD=11.3)<br>85.7% females (f)<br>Comorbidity: cancer | Breathing and visualisations | Ambulatory radiation centre | PSQI>5, self-identified as having insomnia over the last 4 weeks |
| Arem et al. (2019)[9] | N=11<br>Age=52.8(7.1)<br>100%f<br>Comorbidity: cancer (survivor) | CBTI, 90 min sessions over 8 weeks | community and cancer centres | PSQI≥, self-identified as having problems sleeping since cancer diagnosis |
| Bernatchez (2019)[17] | N=6<br>Age range= 57-88 yrs<br>33%f<br>Comorbidity: cancer | CBT-E (CBT-I and environmental changes), 60 min sessions over 3 weeks | Community | DSM-IV diagnosis of insomnia or hypersomnolence |
| Birling et al. (2018)[52] | N=72<br>Age= 46.9 (12.77)<br>79%f | CBT-I, 8x50-90 mins sessions (some in group, some individual) | community and sleep centre | DSM-V diagnostic criteria for insomnia |
| Blom (2016)[20] | N=18<br>Age=46.1 (13.6)<br>51%f<br>Comorbidity: depression | Digital CBT-I, 9 weeks | Community | Research Diagnostic Criteria and ISI>10 |
| Bouchard (2003)[33] | N=39<br>Age=41.44<br>59%f | CBT-I, 8 weeks (50 mins individual, 90 mins group, 30 mins telephone) | Community | Complaint of insomnia, SOL/WASO> 30 min per night, ≥3 nights a week during a 2-week baseline assessment; insomnia duration of ≥6 months; daytime dysfunction |
| Boullin et al. (2017)[54] | N=25<br>Age: 39.62 (13.64 group arm); 42.00 (17.83, individual arm)<br>76%f | CBT-I, 1 session | Community | DSM-V criteria for acute insomnia (between 2 weeks and 3 months) |
| Buchanan et al. (2018)[24] | N=22<br>Age=46 (range 30-59)<br>23%f | Brief behavioural therapy, 4 sessions (2 face-to-face, 2 telephone) | Community | SOL or WASO or EMA reports ≥ 3 nights per week, >=1 month, and associated with daytime dysfunction |

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| | Comorbidity: HIV | | | |
| Chakravorty et al. (2019)[13] | N=11<br>Age=52(7)<br>0%f<br>Comorbidity: alcohol dependence | CBT-I, 8 sessions | Community and local health clinics | ISI≥8 |
| Chambers & Alexander (1992)[44] | N=103<br>Age=39.9 (range 19-75)<br>67%f | CBT-I, 1-4 sessions (majority of first sessions 2-3 hrs) | Sleep clinic | Subjective complaint of insomnia |
| Cui & Fiske (2019)[62] | N=108<br>Age=50.5(14.6)<br>72%f | CBT-I, 6x60-mins sessions | Sleep clinic | DSM-IV-TR criteria |
| Cvengros et al. (2015)[48] | N=30<br>Age=36.4 (14.1)<br>60%f | Behavioural treatment & Mindfulness meditation, 6 weekly sessions (90-120 mins) | Community | ISCD-2 diagnosis of psychophysiological insomnia and SOL/WASO >30 min ≥3 nights per week for at least 1 month |
| Dolsen, 2017[42] | N=188<br>Age=47.4 (12.6)<br>62%f | Cognitive therapy, behavioural therapy or CBT-I, 8 weekly sessions (behavioural and cognitive therapy 45-60 mins, CBT-I 75 mins) | Community and referral | SOL, WASO≥30 min, TST≤6.5 hours per night established with 2-week sleep diary, insomnia≥3 nights per week >6 months significant daytime impairment |
| Dong et al. (2018)[46] | N=188<br>Age=48.5 (13.6, behavioural therapy), 46.7 (12.8, cognitive therapy), 46.9 (11.3, CBT)<br>63.4%f for BT, 70%f for CT, 53%f for CBT | Cognitive therapy, behavioural therapy or CBT-I, 8 weekly sessions (behavioural and cognitive therapy 45-60 mins, CBT-I 75 mins) | Community and referral | DSM-IV-TR criteria |
| Ebert (2015)[31] | N=64<br>Age=48.4 (9.9)<br>70.3%f | Digital CBT-I, 6 sessions (45-60min) | Schools | ISI≥15 |
| Edinger et al. (2009)[59] | N=41 | CBT-I, 4 biweekly sessions, 30-60 mins | Community and referral (health | Research Diagnositc Criteria and SOL +WASO time of >60 min per night |

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| | Age=56.9 (16.3, primary insomnia), 52.0 (11.1, comorbid insomnia)<br>15%f | | centres and VA outpatient mailing lists) | |
| Ellis et al. (2015)[70] | N=20<br>Age=32.9 (14.02)<br>55%f | CBT-I & self-help leaflet, 1 session, 60-70 mins | Community | DSM-V diagnostic criteria for acute insomnia |
| Epstein et al. (2012)[37] | N: SCT=44, SRT=44, MCI=41<br>Age=70.95 (8.33 for stimulus control), 68.00 (8.25 for sleep restriction), 67.22 (6.55 for multi-component therapy)<br>SCT: 71%f, SRT: 57%f, MCI: 66%f | Stimulus control, sleep restriction or both, 6 weeks (4 groups face to face, 2 telephone) | Community | SOL or WASO≥45 min for at least 3 nights per week as determined by 14-day sleep diary, ≥6 months and daytime dysfunction |
| Epstein et al. (2013)[23] | N=41<br>Age= 30.32 (7.73) range=20-58<br>5%f<br>Comorbidity: war veteran with blast exposure and/or other injury with loss of consciousness | CBT-I, 4 weeks (1 face-to-face, 3 telephone), initial group session (M=69.51mins), telephone sessions (M=15.73mins) | Trauma clinic | SOL or WASO>1 month and ISI≥10 and impairment in daytime functioning |
| Garland et al. (2016)[18] | N=43<br>Age= 57.5 (average of CBT-I groups)<br>90%f (just CBT-I groups)<br>Comorbidity: cancer (survivor) | CBT-I and Armodafinil, 7 weekly individual sessions (face-to-face and telephone) | Community and cancer centres | Insomnia> 3 months, SOL/WASO >30 min on≥3 days per week for at least 1 month) started or became worse with diagnosis /cancer treatment |
| Hebert et al. (2010)[57] | N=94<br>62%f | Digital CBT-I | Community and referral | Problems with SOL/WASO or EMA >30 min on 4 days per week for at least 6 months |
| Heenan et al. (2019)[22] | N=47<br>Age= 62.11 (12.12), range 22-88<br>47%f<br>Comorbidity: cardiac rehab | CBT-I, including some cardiac-relevant information, 6x90 mins group sessions | Cardiac rehab centre | DSM-V diagnostic criteria |
| Ho et al., 2014[36] | N=207<br>Age= | Digital CBT-I self-help (without vs with support), | Community | SOL or WASO, EMA or non-restorative sleep with daytime impairment on≥3 nights for≥3 months |

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| | 36.9 (13.0 self help with support), 38.6 (11.8 self-help without support)<br>69%f | 6 weeks (4 face-to-face, 2 by phone) | | |
| Holmqvist (2014)[50] | N: Web-based=39, Telehealth-based=34<br>71.8%f (web) 79.4%f(tele) | Telehealth and digital CBT-I, 6 sessions, 1 Mindfulness session | Community and referral | Research Diagnostic Criteria |
| Horsch (2017a)[45] | N=45<br>Age= 35 (14)<br>67%f | Digital behavioural treatment (progressive muscle relaxation exercises), with reminders to improve adherence | Community | Individuals who suffered from insomnia |
| Horsch et al. (2017b)[56] | N=74<br>Age= 39 (13.0)<br>61%f | Digital CBT-I, 6-7 weeks | Community | DSM-V and ISI≥7 |
| Kaldo (2015)[53] | N=73<br>Age=47(15.2)<br>81%f | Digital CBT-I, 8 weeks | Community | Research Diagnostic Criteria and ISI>10 |
| Kamen et al. (2019)[19+] | N=47<br>Age= 58.88 (30–74, for CBT with placebo); 56.26 (36–73 for CBT-I with Armodafinil)<br>91%f<br>Comorbidity: cancer | CBT-I, 7 sessions (3 face-to-face, 4 telephone) | Community and clinic (cancer) | insomnia≥3 months starting/worsening with cancer treatment |
| Koffel et al. (2018)[51] | N=18<br>Age=48.50 (14.93)<br>61%f | CBT-I and CBT-I coach, 5x60 mins sessions | VA medical centre | Receiving CBT-I in a clinic |
| Lee & Harvey (2015)[21] | N=17<br>Age=39.47 (13.47)<br>59%f<br>Comorbidity: Bipolar | CBT-I-BP,8x50mins weekly individual sessions | Community | SOL or WASO unrefreshing sleep with daytime impairment for 3 days/week for at least the last month |

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| Lovato et al. (2013)[38] | N=86<br>Age=64.10 (6.80), 49-85 (range)<br>52%f | CBT-I, 4x60mins group sessions | Community | WASO >30 min≥3 nights≥6 months, daytime impairment |
| Ludwin et al. (2018)[14] | N=14<br>Age=<br>68.36 (5.03), 60–83 (range)<br>0%f | CBT-I, 6-8x 75mins group sessions | VA medical centre | Self-reported sleep problems |
| Manber et al. (2011)[58] | N=301,<br>Age=49.6 (13.9), 21-88 (range)<br>57.5%f | CBT-I, 7x 90 mins group sessions (first weekly, then biweekly for final 2) | Sleep clinic | Complaint of insomnia confirmed by BSM board certified psychologist or physician |
| Matthews et al. (2012)[10] | N=34<br>Age=53.56 (7.09), 35-65 (range)<br>100%f<br>Comorbidity: cancer | CBTI, 6 sessions (face-to-face and telephone) | Cancer centres and referrals | Insomnia that started or was made worse through diagnosis determined by clinical interview |
| McCrae et al. (2018)[39] | N=32<br>Age=67.97 (5.97)<br>69%f | Brief behavioural therapy, 4 weeks | Community | SOL or WASO >30 minutes≥3 nights per week >6 months, daytime impairment |
| Miller et al. (2013)[71] | N=9<br>Age=46.4 (34-58)<br>67%f | Sleep restriction therapy, 4 sessions (face-to-face and telephone) | Community | Research Diagnostic Criteria |
| Miller et al. (2015)[43] | N=75<br>Age=45.5, 25-60(range)<br>75%f | Sleep restriction therapy | Community | Problems with SOL/WASO or EMA >30 min on ≥ 3 days per week for at least 3 months and daytime impairment |
| Perlis et al. (2004)[49] | N: CBT-I & placebo=9; CBT-I & Modafinil=10<br>Age= 47.4 (1.7, CBT with placebo), 35.0 (11.7, CBT-I & modafinil)<br>67%f (CBT & placebo) 80%f (CBT-I & Modafinil) | CBT-I (with placebo or modafinil),<br>8xweekly sessions, 30-90 mins | Community and sleep centre | ICSD classification of psychophysiological insomnia and ≥30 min SOL≥2 awakenings per night ≥15 min and/or WASO 30 min, TST ≤6 hrs unless SE ≥80%. Problem >4 nights per week with ≥6 months duration, daytime impairment complaint that had to at least be sleepiness/fatigue |

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| Petrov et al. (2014)[30] | N=53<br>Age=18.9 (1.7), 17–25 (range)<br>87%f | Behavioural treatment, 1x 90 mins group session | College | ISI≥8, and ICSD-2 classification, ≥ "sometimes" ≥ 1/11 items of sleep disorders screener |
| Randall et al. (2019)[15] | N=30<br>Age=<br>33.13(8.85)<br>0%f | CBT-I, 1 session | Prison setting | DSM-V criteria (2-3 months duration) for acute insomnia |
| Riedel & Lichstein (2001)[34] | N=22<br>Age=67.96 years (7.07), 60–81 (range)<br>73%f | Sleep restriction therapy, 6 weekly sessions | Community | SOL or WASO >30 min 3x a week for ≥6 months |
| Savard et al. (2016)[11] | N=161<br>Age=52.6 (8.9) (face-to-face CBT), 55.3 (8.7) (video based CBT-I)<br>100%f<br>Comorbidity: cancer | CBT-I (face to face or digital),<br>6 weeks of 50 mins sessions or 6 booklets with 5-20 mins video | Cancer centres | ISI≥8 or use of sleep med ≥ 2x in past 2 weeks |
| Seyedi-Chegeni et al. (2018)[26] | N=45<br>Age=57.37 (12.8)<br>33%f<br>Comorbidity: COPD | Progressive muscle relaxation, 8 weeks | Respiratory clinic | PSQI≥21 |
| Sidani et al. (2015)[60] | N=262<br>Age=56 (16), 21–90 (range),<br>60%f | Behavioural therapy, 4 group sessions, 2 telephone sessions | n/a | SOL or WASO ≥30 min on ≥3 nights per week based on sleep diary and reported problems for ≥3 months based on ISI |
| Sidani et al. (2017)[35]* | N=213<br>Age=56 (16), 21–90 (range),<br>60%f | Behavioural therapy, 4 group sessions, 2 telephone sessions | n/a | SOL or WASO ≥30 min on ≥3 nights per week for ≥3 months based on ISI |
| Smitherman et al. (2016)[25] | N=16<br>Age=29.6 (13.4)<br>94%f | Behavioural therapy, 3x30 mins biweekly sessions | Community and neurology clinic | ICSD-3 criteria for insomnia |

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| | Comorbidity: chronic migraines | | | |
| Tamura & Tanaka (2017)[32] | N=28<br>Age=67.21 (8.33)<br>71%f | Behavioural treatment, single 2-hour group session | Public health centre | SOL or WASO >30 min and >10 points on ISI (Japanese version) |
| Taylor et al. (2014)[61] | N=17<br>Age=19.47 (1.66), 17-25(range)<br>24%f | CBT-I,<br>6x individual sessions | Student sample | DSM-V insomnia criteria |
| Tremblay et al. (2009)[12] | N=57<br>Age=54.05 (7.36)<br>100%f<br>Comorbidity: cancer | CBT-I,<br>8x weekly 90 mins group sessions | Community and referrals | SOL or WASO >30 min, SE <85%, ≥3 nights per week≥6 months, daytime impairment |
| Trockel et al. (2014)[64] | N=696<br>Age=52(14), 22-85 (range)<br>10%f | CBT-I, 5 sessions | Clinic (VA) | DSM-IV insomnia criteria |
| Vincent & Hameed (2003)[63] | N=50<br>Age=51.4(11.4)<br>66%f | CBT-I,<br>7x weekly 90 mins group sessions | Community and referral | DSM-IV TR and TST <6.5 hrs SOL >45 or WASO>30 and≥4 hrs for≥6 months and two daytime areas of impairment |
| Vincent et al. (2008)[40] | N=40<br>Age=46.9 (11.9)<br>50%f | CBT-I, 6xweekly group sessions | Sleep clinic | SOL or WASo or EMA≥30 min or non restorative sleep≥3 nights per week≥6 months with ≥2 daytime impairment areas |
| Vincent & Lewycky (2009)[41] | N=59<br>68%f | Digital CBT-I, 5 sessions | Community and referrals to sleep clinic | SOL or WASO ≥30 min, 1 daytime impairment and ≥ 6 months ≥ nights per week |

CBT-I= Cognitive Behaviour Therapy for Insomnia, DSM=Diagnostic and Statistical Manual of Mental Disorders, EMA= Early morning awakenings, ICSD= International Classification of Sleep Disorders, ISI= Insomnia Severity Index, PSQI= Pittsburgh Sleep Quality Index, SD=standard deviation, SOL= Sleep onset latency, TST=Total sleep time WASO= Wake after sleep onset, * same trial as Savard et al. 2015, + same trial as Garland 2006 Summary of subjective adherence data

Table 2: Subjective adherence measures, magnitude, correlation with outcomes and predictors

| Author, year | Adherence measure | Quality rating: description of adherence measure | Quality rating: measure of adherence | Magnitude of adherence | Correlation between adherence and outcomes | Predictors/correlates of adherence | Non-predictors/correlates of adherence |
|---|---|---|---|---|---|---|---|
| Absolon et al. (2016)[16] | % of participants who were able to follow treatment recommendation for at least 24/30 days | High | Low | 75% | Not associated with any treatment variables | | Baseline variable |
| Arem et al. (2019)[9] | % of participants who reported home practice as "very often" | Low | Low | 71% | | | |
| Bernatchez et al. (2019)[17] | % of time strategies were applied | Low | Low | 65% (median) | | | |
| Blom et al. (2016)[20] | How often treatment components were used on a 5 point scale (0 not at all-4 very much) | Low | Low | | | | |
| Buchanan et al. (2018)[24] | Self-report (how well did you adhere to treatment on | | | 5.0 (1.5-7.0) for self-report; | | | |

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| | scale 0-7, higher score indicating better adherence) | | | | | | |
| Chambers & Alexander (1992)[44] | Self-reported compliance | Low | Low | | Adherence did not predict treatment outcomes | | |
| Ebert et al. (2015)[31] | Participants were asked if they completed exercises at home "completely, partly, or not at all." | Low | Low | [reported here for % implementing exercise completely] 50.88 for utilisation of recreational activities; 35.09% for stimulus control and sleep restriction, 63% for sleep restriction specifically; 35.09% for strategies overcoming persevative cognitions | indirect effects of increased recreational activities that was associated with reduced perservative cognitions and this with the reduction of sleeping problems (( 0.11, SE .07, 95% CI: 0.41 to 0.02) | | |
| Edinger et al. (2009)[59] | How many days per week implemented each of the 6 core elements of the treatment (standard rise time, avoidance of naps, not worrying in bed, use of the bed only for sleeping, | High | Low | Mean of 6.23 days per week adherent | | | |

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| | adherence to TIB prescription, getting out of bed when unable to sleep) and adherence to each item was averaged. | | | | | | |
| Epstein et al. (2012)[37] | i) Self report (0-4 with higher scores better adherence) and ii) questions about adherence to specific behaviours e.g. did you adhere to the QHR | Low | Low | i) No means reported for self-reports<br>ii) 89.3% (± 9.5) for SCT, 87.3% (± 10.2) for SRT, and 90.0% (± 8.5) for MCI. | | | |
| Epstein et al. (2013)[23] | Self-report questionnaire (how often did you implement components, scale not clear) and % of veterans using audio files | Low | Low | 28% indicated very much. Use of audio files: guided imagery 40.7 -79.4 % depending on treatment week; breathing awareness 25.9-58.8%; body scan 22.2-61.8% | | | |
| Hebert et al. (2010)[57] | % of homework practice for at least 4 nights of the week | High | Low | Clock-watching (70.0%), caffeine (60.9%) and alcohol taper (95.6%), avoiding heavy meals before bed (87.0%), sleeping separately | | Perceived behavioural control, support, and higher intention were associated with adherence to sleep hygiene | |

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| | | | | from noisy bed partner (87%), exercising (39%), tapering liquids before bed (60.9%), temperature control in bedroom (87%), avoidance of napping (82.6%), regular sleep schedule (82.6%), avoiding reading or TV viewing in bed (82.6%), abdominal breathing (60.0%), progressive muscle relaxation (38.8%), imagery-induced relaxation (38.8%), hypnosis (41.2%), and sleep restriction (44.4%). | | practices. More contemplative individuals were more likely to adhere to exercise and tapering caffeinated beverages | |
| Ho et al. (2014)[36] | how far they had followed instructions (all, almost all or more than half) | Low | Low | | | | Support |
| Holmqvist et al. (2014)[50] | Use of homework on >4 nights per week | Low | Low | Telehealth: 75% (clockwatching), 73% (relaxation), 72% (sleep restriction and stimulus control) 47.8% (cognitive therapy), 95% (sleep hygiene)... Online CBT-I: 65% | | web vs telehealth | |

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| | | | | (clockwatching), 72.7% (relaxation), 95% (sleep restriction and stimulus control) 80% (cognitive therapy), 100% (sleep hygiene)... | | | |
| Horsch et al. (2017a)[56] | How often the relaxation exercises were used (in days) | High | Low | Median 0 (IQR6, for no reminders), median 1 (IQR 3 for self-set reminder) and 1 (IQR 5 for system set reminder) | | reminders vs no reminders, appreciation for the relaxation exercises and ability to use the phone | type of reminder (self or system set), self-empowerment or opportunity (opportunity to do the relaxation exercises was available), acceptance and use of technology, locus of control, insomnia severity, behavioural intention |
| Horsch et al. (2017b)[45] | Number of relaxation exercises performed (also reported % with >35 relaxation exercises) | High | Low | Mean of 49 relaxation exercises completed, (10% of participants adherent for relaxation) | | | |
| Kaldo et al. (2015)[53] | Hours spent each week using treatment methods | Low | Low | Mean 6.1 hrs (SD= 4.5) | | | |
| Lee & Harvey (2015)[21] | Self-report assessing on a scale of 0-100 to what extent they completed the homework assignment with higher scores | High | Low | Mean=82.08 (SD=17.02) homework compliance | | | recall of therapy components, how many therapy components were delivered per session |

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| | indicating better adherence | | | | | | |
| Manber et al. (2011)[58] | Self-report scale from 0-3 for each of the 6 components with higher scores indicating better adherence | High | Low | Mean of 1.69-2.33 for high depression group and 1.85-2.49 for low depression group | Adherence related to lower posttreatment ISI scores | lower depression scores, esp for rise time and TIB (no diff for conitive components | |
| McCrae et al. (2018)[39] | Self-report logs for sleep hygiene behaviours , stimulus control components and relaxation practice (supposed to practice 2x day and specify time), and then reported % of items that were adhered to | | | Sleep hygiene: 86.19% (SD20.13), Stimulus Control 83.01% (SD20.21) and Relaxation 68.83% (SD 30.43) | | Adherence higher for sleep hygiene than stimulus control and relaxation | |
| Miller (2013)[71] | Sleep restriction adherence scale (range 5-30, greater score more adherence | Low | High | week 1 = 26.1 (3.5), week 2 = 24.0 (3.8), week 3 = 25.1 (1.3), week 4 = 23.1 (6.1) | | | |
| Miller (2015)[43] | Sleep restriction adherence scale (range 5-30, | Low | High | >20 on SRAS, "adherence suggested on sleep diary" | | | |

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| | greater score more adherence) | | | | | | |
| Ruiter Petrov et al. (2014)[30] | Self-report asking whether they implemented 11 behaviours then average % of behaviours adhered to over the 14-day FU period | High | Low | On average 77 % of stimulus control instructions and 85% of sleep hygiene instructions were adhered to | | Bed partner or pet and higher treatment-related self-efficacy associated with stimulus control adherence. Treatment-related self-efficacy and less alcohol use were associated with better sleep hygiene adherence. | Baseline variables not related to SH adherence; baseline variables (except bed partner/pet and treatment related self-efficacy) not related to SCT adherence |
| Savard et al. (2016)[11] | % of participants implementing strategies at least "moderately" or at least "a lot" or "extremely" | Low | Low | Implementing moderately: 100% behavioural, 94% cognitive and 100% sleep hygiene; implemeting a lot or extremely: 97% for behavioural 65% for cognitive and 93% for sleep hygiene | | | |
| Seyedi-Chegeni et al. (2018)[26] | Self report duration and time of relaxation practice at home (were told to practice 2 times | High | Low | Average exercise time 50 min and 1.8 times per day | | | |

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| | per day for 30 min each) | | | | | | |
| Sidani et al. (2015)[60] | i) On diary indicated whether (1) used the bed for sleep only (2) getting out of bed when unable to fall asleep or fall back to sleep within 15 to 20 minutes, and (3) taking a nap in bed only if necessary. Adherence was conceptualised as the number of days, within each treatment week, that each recommendation was applied and no. of days it was not needed. ii) overall rating scale measured overall adherence to treatment (five-point scale ranging from not at all (0) to very much (4)). | High | Low | i) Use of bed for sleep only reported in days per week: applied on average (randomised=6.3-6.5; preference=6.1-6.4), non-applicable (randomised=0.5-0.6; preference=0.14-0.23)<br>Got out of bed: applied (randomised=1.6-2; preference=1.3-1.9), non-applicable (randomised=2.3-2.9; preference=2.3-3.3)<br>Took nap in bed: applied (randomised=0.7-1; preference=0.4-0.7), non-applicable (randomised=4.7-5.2; preference=4.8-5.3)<br>ii) Mean overall compliance score: (random group=3.1) (preference group=2.9) | | | Group (allocated based on treatment preference or randomised to treatment) |
| Sidani et al. (2017)[35] | Self-report on a scale of 0-4 with | Low | Low | | | suitability of the treatment, | utility, therapist competence and interpersonal style, perceived benefits on |

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| | higher rates indicating better adherence | | | | | overall attitude towards and desire for continued treatment use | insomnia/everyday functioning, satisfaction with format and dose of treament; satisfaction with outcomes and attribution of outcomes to treatment |
| Smitherman et al. (2016)[25] | Self-report on a scale of 1-5 with higher scores indicating more frequent implementation (nearly every day) | High | Low | Mean= 4.3 (SD= 0.4) | | | |
| Taylor et al. (2014)[61] | Self-report to indicate whether they were adherent to various behaviours each day of the week | Low | High | | | | |
| Tamura & Tanaka (2017)[32] | Self-reported how often practiced any of the sleep-promoting behaviours with scores from 0-23. Also reported % practice individual behaviours | Low | Low | Went from 8.89 (4.84) at baseline to 7.25 (4.29) at posttreatment. The only change in the sleep-promoting behaviours was exposure to sunlight in the morning. % implementing behaviours at posttreatment ranged from 35.7 to 85.7 | | | |

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| Vincent et al. (2008)[40] | Self-report rating about adherence in general from 1-6 with higher scores (range 5-30) indicating better adherence | | | Mean= 21.4. | | Barriers (discomfort, annoyance, boredom) | PBC, pretreatment sleepiness, gender, postsecondary education status |
| Vincent & Lewycky (2009)[41] | n of participants practicing home work >4 nights per week each week | Low | Low | Clock-watching (73.9%), sleep hygiene (76.8%), stimulus control (64.2%), relaxation training (67.6%), sleep restriction (51.6%) hypnotic tapering (22.6%). (relaxation types: paced breathing exercises 48%, PMR 22%, hypnosis 22%, imagery-induced relaxation 22% | | | |

Table 3: Quasi-objective adherence measures, magnitude, correlation with outcomes and predictors

| Author, year | Adherence measure | Quality rating: description of adherence measure | Quality rating: measure of adherence | Magnitude of adherence | Correlation between adherence and outcomes | Predictors/correlates of adherence | Non-predictors/correlates of adherence |
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| Birling et al. (2018)[52] | TIB difference, calculated by subtracting prescribed TIB from mean TIB reported in the sleep diary | High | High | | | | |
| Bouchard et al. (2003)[33] | Recorded the presence or absence of 7 behaviours based on a sleep diary, then combined this score for min 0 and max 49 score (Behaviours evaluated included: bedtime more than 15 min prior to prescribed time, get up more than 30 min after prescribed time, doesn't get out of bed if awake for more than 30 min, naps>60 min and after 3pm, not following evening routine, used bed for non-sleeping activities) | High | High | Ranged from M=42.35 (SD=5.32) in week 2 to M=45.61 (SD=3.35) in week 7 | | Self-efficacy | |
| Boullin et al. (2017)[54] | Adherent if TIB that on average was 15 minute within prescribed TIB | High | High | 53.85% (group treatment) 91.67% (individual treatment arm) | | Indvidual treatment arm | |
| Chakravorty et al. (2019)[13] | Adherent if difference between TIB and pTIB in total (for the week) <105 minutes | High | High | 90.9 | | | |

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| Cui & Fiske (2019)[62] | Standard deviation in bed and rise times (higher SD poorer adherence) based on weekly averages | High | High | 27.1 (SD 29.0) min [bedtime], 40.4 (SD 25.9) min [risetime] | | Higher age, fewer depression symptoms | Gender, ethincity, education, employment, insurance, marital status, number of health problems, anxiety, baseline PSQI, ISI or ESS |
| Cvengros et al. (2015)[48] | Difference between TIB/risetime and prescribed TIB/risetime and then calculated % of days/35 when TIB was no more than >30 earlier and rise time was no more than 60 min later | High | High | Mean total TIB=22 (SD 38.3) minutes more than prescribed, rise time=30.5 minutes (SD 36.4) later than prescribed; participants were adherent with TIB recommendations on 61.6% of days (SD=27.4, range=0-96.4%), and rise time recommendations 72.4% of days (SD=24.8, range=17.1-100%) | | Fewer dysfunctional beliefs (to TIB and rise time) and less severe insomnia (to rise time) | Age, gender, ethnicity, years of education, duration of insomnia |
| Dong et al. (2018)[46] | 1. Calculated n of adherent days per week for each criterion: bedtime ≤15 min before prescribed bedtime, | High | High | 1. Bedtime: 6.17 days (SD 0.92); Rise time 5.08 days (SD 1.39); naps 5.91 days | Beta -0.18 for overall adherence and insomnia improvement. Beta -0.22 for getting out of bed during night and ISI | Pre-treatment fatigue (for global adherence to behavioural strategies) | Psychiatric comorbidities, daytime impairment, treatment expectation at session 1, duration |

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| | risetime ≤30 min after the prescribed risetime, 20 min rule in the middle of the night, nap before 3pm and ≤60 min, TIB ≤30 min within pTIB. | | | (SD 1.56); Sleep window 5.05 days (SD 1.41); Getting out of bed during night awakenings 4.51 days (SD 2.11) | change at posttreatment and at FU. Insomnia remission and overall adherence OR 1.99 at posttreatment and OR 1.54 at 6- month FU. Getting out of bed and remission OR 2.63 at posttreatment and OR 2.23 at 6 month FU. Adherence to bedtime, risetime, napping and sleep window did not significantly predict outcomes. | | of insomnia, dysfunctional beliefs about sleep and sleep-related safety behaviours (some of these were reported as significant trends) |
| Edinger et al. (2009)[59] | 2. standard deviations in TIB and rise time from baseline to post-treatment from the sleep diary | High | High | Magnitude of TIB/rise time variance not reported | | | |
| Ellis et al. (2015)[70] | % of participants within 15 min of their pTIB and % of participants within 30 min of their prescribed TIB | High | High | 60% within 15 min, 65% within 30 min of prescribed TIB | | | |
| Garland et al. (2016)[18] | % of participants within 30 min of their TIB | High | High | 67.6 (CBT+A) 54.78 (CBT+P) | | | not whether assigned to placebo or armodafinil |
| Heenan et al. (2019)[22] | Average difference between bedtime and prescribed bedtime | Low | High | | No correlation with sleep diary and questionnaire outcome measures | | |
| Horsch et al. (2017b)[56] | Difference between TIB and prescribed TIB (also reported % with diff <60 min) | High | High | M difference to prescribed TIB of 59.2 minutes (SD 46.4) (68% | | | |

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| | | | | adherent to sleep restriction) | | | |
| Kamen et al. (2019)[19] | Difference in time of bed and prescribed TIB>30 minutes, then dichotomous yes no for adherent vs not adherent | High | High | 37.5 week 1, then ranged between 60-75.7 % (depending on week of treatment) | | social support | |
| Lovato et al. (2013)[38] | Difference between TIB and pTIB | Low | High | TIB not significantly different from prescribed time in bed | | | |
| Ludwin et al. (2018)[14] | 1. Difference between TIB and prescribed TIB in the final week, participants considered adherent if diff score <1 and non-adherent if difference >0; 2. rise time variability during initial and final treatment weeks and 3. variability of TIB during the initial and final treatment weeks with greater variability indicating poorer adherence | High | High | 1. 57% had a diff score between TIB and pTIB that was <1 None had a diff score >30 minutes 2. Median rise variability went from (.42) (.08–1.05) 0.21 (0.05-0.56) 3. Median TIB variance went from (.62) (.30–1.23) to 0.34 (0.13-0.65) | No correlation with ISI, SE, WASO, SL, TST (although moderate negative relationships of some outcomes with rise time variability) | | |
| Matthews et al. (2012)[10] | N of days that bedtime/risetime were within 15 minutes of prescribed time, and TIB was within 30 | High | High | 3-4.1 (rise time), 4.2-5.1 (TIB) and 5.4-6.1 days (bedtime) | r=.35 (for prescribed bedtime and reported awakenings per night. r=.38 (for prescribed bedtime and TST) and | Chemotherapy (vs other treatments for bedtime and TIB), motivation (for TIB and rise time), lower fatigue (for rise time) | age, full-time employment, marital status, radiation, months since diagnosis, insomnia |

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| | minutes of prescribed time | | | | r=.32 (for prescribed TIB and TST) | | severity, anxiety and depression |
| McCrae et al. (2018)[39] | 1. Diff between TIB and prescribed TIB and 2. Difference in pre and post treatment TIB | High | High | No difference between TIB and pTIB. There was a reduction in TIB from baseline to late treatment, posttreatment but not at FU. | | | |
| Miller et al. (2013)[72] | 2. TIB reduction from pre to posttreatment | Low | High | Significant reduction in TIB from pre to posttreatment (489 versus 367 min) | | | |
| Miller et al. (2015)[43] | TIB reduction from pre to posttreatment | Low | High | Significant reduction in TIB from pre to posttreatment (526 versus 428 min) | | | |
| Perlis et al. (2004)[49] | Difference between bedtime and prescribed bedtime. If it was later or the same, then assigned 0, and if all the weekly values (sum) were at least 105 minutes then deemed non-adherent. (That equates to on average | High | High | 80% CBT with modafinil, 51% CBT with placebo | | Modafinil | |

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| | 15 minute deviation per day). Adherence was conceptualised as % of participants considered adherent | | | | | | |
| Ruiter Petrov et al. (2014)[30] | Standard deviation in rise time and % of participants who were more than 30 min diff | High | High | 81.6 min deviation from rise time (SD 96.5, range 0–540.0.) 47% of participants were <31 min diff from their prescribed rise time. | | | |
| Randall et al. (2019)[15] | n of nights that participants were within 15 minutes of their prescribed bedtime or rise time on their 1-week posttherapy diary | Low | High | 90% | | | |
| Riedel & Lichstein (2001)[34] | 1. Difference in TIB and prescribed TIB 2. % of time in bed reduction that was adhered to (in %) 3. Change in TIB from baseline to post-treatment 4. Time in bed variance 5. Rise time variance | High | High | 1. 27.89 min (SD 31.72) more time in bed, 64% were within 30 min of TIB and 36% within 15 min of prescribed TIB 2. adherence of 68.99 (SD 26.31) % 3. TIB posttreatment was (M=400.39, SD=69.90) and this was sig lower than baseline (M=467.92, SD=66.24) 4. | r= 0.51 for WASO and TIB variance; r=0.44 for Rise variance and Awakenings, r=-0.51 for TIB variance and sleep efficiency, and r=-0.60 for sleep quality and rise time variance. Adherence to combined score for TIB difference/TIB %, rise variance and TIB variance was associated with reduced WASO and improved sleep quality | | |

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| | | | | variance of TIB at baseline (4095.01) and post-treatment (1189.80). 5. Rise time variance 1790.86 at baseline and 692.37 at posttreatment | | | |
| Tamura & Tanaka (2017)[32] | 1. Variance in bedtime and rise time , | Low | High | Bedtime variance reduced from 2.61 (2.40) at baseline to 2.35 (1.86) at posttreatment; Rise time variance reduced from 8.89 (4.84) at baseline to 7.25 (4.29) at posttreatment. | | | |
| Taylor et al. (2014)[61] | Difference between TIB and prescribed TIB, and difference between rise time and prescribed rise time. | Low | High | Difference of 7.65 minutes between actual bedtime and prescribed bedtime; difference of 20.61 minutes between prescribed rise time and actual rise time | | | |
| Tremblay et al. (2009)[12] | Dichotomous yes/no for 5 criteria: 1. <15 min within bedtime, after the 6th session that turned to >30 min | High | High | Overall: 88.83 % days (SE 8.48), Bedtime: 89.20 % days (SE 11.60), Rise time: | Association between adherence to not napping and change in objective WASO (B(beta)=-0.41), | | |

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| | earlier and then computed the sum of all bedtimes / n of days 2. same as 1. but for rise time 3. getting up within 30 min of awakenings in the night, 4. any naps <60 and ending before 3.15pm, 5. TIB,<30 min different to prescribed TIB. Then % of days that the participant was adherent was calcuated from the days between session 3 and end of CBT-I | | | 78.36 % days (SE 15.60), Avoidance of napping 95.63 % days (SE 6.02), Rising during the night if awake: 97.73 % days (SE 4.33), Adherence to TIB: 83.20% days (SE 17.20) | TST (0.41) and Sleep efficiency (0.38). | | |
| Vincent & Hameed (2003)[63] | Consistency of bedtime, consistency of wake time (Standard deviations at 14 days pre and post treatment), | High | High | | Tapering of sleep meds at posttreatment was related to more consistent wake time r= –.49. | | Anxiety, dysthymia |
| Vincent et al. (2008)[40] | Consistency of wake time | Low | High | Significant improvement in variance of rise time (pre 1.2 hrs, SD 0.68; post 0.91hrs, SD 0.58) | No correlation with wake time consistency | , Younger age, less sleepiness | Barriers, perceived behavioural control Gender, postsecondary education status |

Table 4: Objective adherence measures, magnitude, correlation with outcomes and predictors

| Author, year | Adherence measure | Quality rating: description of adherence measure | Quality rating: measure of adherence | Magnitude of adherence | Correlation between adherence and outcomes | Predictors/correlates of adherence | Non-predictors/correlates of adherence |
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| Dolsen et al. (2017)[42] | Therapist adherence scale (0-100, "To what extent did your patient complete the practice exercises outside of session this past week?" (0% to 100% with 10% increments") | High | High | | | More total wake time after the session (but this was reversed later on in treatment); longer TST (later on in treatment) | |
| Dong et al. (2018)[46] | Therapist adherence scale (0-100, "To what extent did your patient complete the practice exercises outside of this session?" | | | Mean= 80.99, (SD=17.85) | ISI reduction post-treatment ($b$ = −0.14, $p$ = 0.045), remission at post-treatment (OR = 1.84, $p$ = 0.008). | | Psychiatric comorbidities, daytime fatigue, daytime impairment, treatment expectation at session 1, duration of insomnia, dysfunctional beliefs about sleep and sleep-related safety behaviours |
| Koffel et al. (2018)[51] | Therapist rated scale for six treatment recommnedations, scale 1-6 with higher scores | High | High | | | | CBT-I coach or not |

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| | indicating better adherence | | | | | | |
| Trockel et al. (2014)[64] | Therapist rated scale for six treatment recommnedations, scale 1-6 with higher scores indicating better adherence. Then split group into terciles (high med low adherence) | High | High | | d=0.95, higher adherence had 4.1 points greater ISI reduction compared to lower group | | Therapeutic alliance |
| Vincent & Hameed (2003)[63] | Therapist questionnaire (on a scale of 1-5 with higher scores indicating better adherence for 5 components of CBT-I) and spouse questionnaire with a range of 5-25 with higher . Adherence to multiple behaviours was assessed in the spouse questionnaire (relaxation practice, sleep diary completion, changes to night routine, QHR, | High | High | 47% rated at least very much adherent on therapist questionnaire. Average score on spouse questionnaire was 20.58, highest score was for diary completion, then bedtime routine, sleep restriction and then relaxation training. | Therapist rated adherence was related to reduction in dysfunctional beliefs, less sleep related impairment, better sleep quality; not related to post-treatment SOL or sleep efficiency. Spouse rating not related to outcomes. | No dysthymia related to higher therapist-rated adherence; | Anxiety, medication use, depression |

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