Journal of Psychiatric Research 179 (2024) 286–294

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

# The effect of weighted blankets on sleep quality and mental health symptoms in people with psychiatric disorders in inpatient and outpatient settings: A systematic review and meta-analysis☆

Stanley Wong [a,*], Nicholas Fabiano [b], Brandon Luu [c], Chanhee Seo [d], Arnav Gupta [d,e], Helena K. Kim [a], Risa Shorr [f], Brett D.M. Jones [a,g], Michael S.B. Mak [a,h,i], M. Ishrat Husain [a,g]

[a] Department of Psychiatry, Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
[b] Department of Psychiatry, University of Ottawa, Ottawa, Ontario, Canada
[c] Department of Internal Medicine, University of Toronto, Ontario, Canada
[d] Department of Internal Medicine, University of Calgary, Calgary, Canada
[e] College of Public Health, Kent State University, Ohio, United States
[f] Library Services, The Ottawa Hospital, Ottawa, Ontario, Canada
[g] Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, Ontario, Canada
[h] Department of Medicine, McMaster University, Hamilton, Ontario, Canada
[i] Department of Psychiatry, Western University, London, Ontario, Canada

ARTICLE INFO

*Keywords:*
Weighted blankets
Deep pressure therapy
Psychiatric disorders
Sleep

ABSTRACT

There is limited synthesized evidence for weighted blankets usage in psychiatric patients. We performed a PRISMA compliant systematic review and meta-analysis of the effects of weighted blankets on sleep and mental health outcomes in psychiatric patients. MEDLINE, EMBASE, Cochrane Library, and PsycINFO were searched up to December 15th, 2023. Randomized controlled trials (RCT) or cohort studies reporting objective outcome scales of sleep and mental health were included. Standardized mean difference (SMD) measured effect size. Q and $I^2$ tests measured heterogeneity. Cochrane Risk of Bias Tool 2 and NIH Quality Assessment Tool assessed risk of bias. Nine studies of 553 psychiatric inpatients and outpatients with diagnoses including depression, bipolar disorder, ADHD, and autism. 289 participants received weighted blankets and 264 were in control groups. Intervention length ranged from 5 min to one year. Four studies reported evidence for weighted blankets in improving insomnia, total sleep time, and sleep onset latency. Six studies reported evidence for reducing anxiety symptoms. When compared to placebo, those using weighted blankets had improvements to anxiety symptoms (SMD = −0.47, 95% CI: −0.68 to −0.25, $p < 0.001$). One RCT had low risk of bias, 3 had some concerns, 1 was high risk. Three cohort studies were "fair" and one was "poor" in quality. It was found that weighted blankets can be effective in reducing anxiety in psychiatric patients. However, the literature is limited by heterogeneity of outcome reporting, lack of well designed RCTs, and small sample sizes. Highlighting the need for higher quality studies.

## 1. Introduction

Sleep disturbances are a common feature among numerous psychiatric disorders (Boland et al., 2023; Freeman et al., 2020; Hertenstein et al., 2019; Palagini et al., 2022). These include patients with major depressive disorder (MDD), post-traumatic stress disorder (PTSD), anorexia nervosa (AN), and schizophrenia (Baglioni et al., 2016). There are also links established between sleep in cognitive disorders such as attention deficit hyperactivity disorder (ADHD) (Becker et al., 2017; Cortese et al., 2022; Cortese and Angriman, 2017; Díaz-Román et al., 2018; Hanć and Cortese, 2018; Konofal et al., 2010; Lecendreux and Cortese, 2007). This link also implicated in cognitive disengagement syndrome (CDS which is a syndrome that includes symptoms such as daydreaming, mental confusion, difficulty putting thoughts into words,

☆ All authors have seen and approved the manuscript.

* Corresponding author. Centre for Addiction and Mental Health, 1051 Queen St. W, Toronto, Ontario, M6J1H4, Canada.
*E-mail address:* sta.wong@mail.utoronto.ca (S. Wong).

https://doi.org/10.1016/j.jpsychires.2024.09.027
Received 27 April 2024; Received in revised form 6 September 2024; Accepted 21 September 2024
Available online 22 September 2024

and hypoactivity (Becker et al., 2014, 2023; Burns and Becker, 2021; Langberg et al., 2014; Sadeghi-Bahmani et al., 2022, 2023; Sadeghi-Bahmani and Brand, 2022; Smith et al., 2019, 2020). Furthermore, sleep and sleep disturbances have implications on social performance including isolation, emotional regulation, and emotion recognition (Ben Simon and Walker, 2018; Goldstein and Walker, 2014; van der Helm et al., 2010).

Disturbances in sleep can also be diagnostic features for psychiatric disorders. For example, patients with depression may present with insomnia or hypersomnia and patients with mania often present with a decreased need for sleep. Sleep deprivation can also predispose people to an increased risk of developing a psychiatric disorder or precipitate an episode. Sleep disturbances have been associated with adverse effects on emotional, interpersonal, cognitive functioning and suicidal behaviors in people with psychiatric disorders (Kahn et al., 2013; Rasch and Born, 2013). There is emerging evidence showing that sleep disturbances are a potential risk factor for suicidal behaviors (Becker et al., 2018; Gangwisch et al., 2010). It is thus crucial to not only evaluate sleep patterns in psychiatric patients but also identify potential interventions where possible.

Given the impact of sleep disturbances on mental health, restoring normal sleep patterns is important (Palagini et al., 2013). Pharmacological treatments of sleep disturbances, including hypnotics, benzodiazepines, antidepressants, and antipsychotics, have varying levels of safety and efficacy (Schroeck et al., 2016; Sys et al., 2020). While pharmacological approaches to sleep disturbances are frequently adopted, they can lead to issues including dependency, lack of efficacy in treating chronic sleep disturbances, and polypharmacy (Kanji et al., 2016; Rios et al., 2019). Mainstay non-pharmacological treatments for sleep disturbances include sleep hygiene, cognitive behavioral therapy for insomnia (CBT-I), and exercise (Chennaoui et al., 2015; Kalak et al., 2012; Kredlow et al., 2015; Sharafkhaneh et al., 2022; van Straten et al., 2018; Yang et al., 2019; Zhu et al., 2023). However, the efficacy of non-pharmacological treatments remain unclear, with CBT-I having the best evidence in improving sleep in people in general but also in those with mood and anxiety disorders (Gee et al., 2019; Miller et al., 2019; Montgomery and Dennis, 2004; Staines et al., 2022).

An alternative non-pharmacological treatment is the use of weighted blankets to normalize sleeping patterns (Ackerley et al., 2015; Chi, 2013). Weighted blankets are blankets that contain small compartments where metal chains or beads have been sewn in to add extra weight. They are used in occupational therapy (OT) to help improve emotional and physical regulation (Staines et al., 2022). Specifically, weighted blankets are used in a type of OT known as sensory integration therapy by providing deep touch pressure (DTP) stimulation that anchors on sensory experiences and a calming effect that aids sleep by potentially causing activation of the parasympathetic nervous system resulting in lowering of blood pressure, heart rate, and blood cortisol levels (Dueren et al., 2022; Mullen et al., 2008; Sumioka et al., 2013).

Weighted blankets have been well studied in children with autism with mixed evidence on improvements in sleep quality (Grandin, 1992; Gringras et al., 2014; Sys et al., 2020). There is emerging evidence of the positive benefits to sleep quality and length, mood, and anxiety symptoms in the general population, suggesting that weighted blankets may be beneficial in patients with psychiatric disorders as well (Eron et al., 2020; Green et al., 2020; Hjort Telhede et al., 2022). In addition to the potential effectiveness of weight blankets for sleep, they are also relatively inexpensive in comparison to continual use of some medications in patients without drug coverage. They are also a non-pharmacological approach that may be favored by patients who experience problematic side effects with medication, or those at higher risk of dependency.

Weighted blankets may be a low barrier and scalable treatment for sleep disturbances. However, the literature on the effects of weighted blankets on patients with psychiatric disorders is limited. Establishing whether weighted blankets could be an effective intervention in persons with psychiatric disorders is important given evidence supporting that improved sleep-maintenance has positive effects on daytime activity levels, fatigue, symptoms of depression, and anxiety in patients with psychiatric disorders (Ekholm et al., 2020). To our knowledge, no published systematic review has evaluated the effects of weighted blankets on sleep and mental health in patients with psychiatric disorders. Therefore, the aim of this systematic review is to synthesize the current evidence on the effects of weighted blankets on patients with psychiatric disorders with regards to their sleep and mental health related symptoms.

## 2. Methods

This systematic review was registered and accessible on PROSPERO (CRD42023488048). This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) (Supplementary Fig. 2). One amendment was made to include nested-case controlled studies for more comprehensive review and meta-analysis.

### 2.1. Search strategy and inclusion criteria

MEDLINE, EMBASE, Cochrane Library, and PsychINFO were searched up to December 15, 2023 for randomized controlled trials (RCTs), nested case-control, and cohort studies (prospective and retrospective) of the effect of weighted blankets on patients with psychiatric disorders in terms of sleep and mental health symptoms. A librarian (RS) was consulted to optimize the search strategy. The key words used in the search included *weighted blankets, psychiatric disorders, mental disorders, and deep pressure therapy*. There were no restrictions based on the date of publication. No limitations were set for languages. Conference abstracts and gray literature were included if meeting inclusion criteria. A manual search of references and Google Scholar was conducted to ensure all relevant articles were included.

Inclusion criteria were: (1) RCT study design or cohort studies (both retrospective and prospective), (2) participants had a psychiatric disorder diagnosed using the Diagnostic and Statistical Manual of Mental Disorders (DSM) or the International Classifications of Diseases (ICD), (3) studies were using weighted blankets, weighted vests or other forms of deep pressure therapy as adjunct or single modality treatment for their psychiatric disorder, (4) reported on the effects of weighted blankets on sleep and/or mental health symptoms using quantitative scales. The search strategy presented can be found on Supplementary Table 1.

### 2.2. Screening

The studies found from our search were imported into Covidence for screening (Veritas Health Innovation, n.d.). This process was completed independently in duplicate by the authors (SW, BL, NF, AG, CS) with discrepancies being resolved by a third author. All references of included studies were screened with the same systematic approach to include all relevant studies.

### 2.3. Extraction

Extraction was completed in duplicate (SW, BL, CS) and each author independently extracted relevant data from the included articles and record into a Microsoft Excel spreadsheet that was designed *a priori*, with discrepancies resolved through consensus. The primary outcomes examined were sleep quality and mental health symptom changes as measured by standardized objective scales or devices such as actigraphy for sleep outcomes or standardized anxiety or depression scales for mental health outcomes.

For each study, we extracted the standard identifiers (PMID or DOI), registered trial number, trial sponsors, if the study was industry-funded or not, first author name, year of publication, country of study, number of participants, study design, completion rate, random sequence

generation/randomization/allocation concealment/blinding/possible attrition bias/possible reporting bias/loss to follow-up, other sources of bias, as applicable, study length, duration of follow-up, demographics (age, sex, ethnicity), psychiatric disorders, comorbid medical or physical conditions, information regarding the weighted blankets used and control conditions, comparator, method of data collection, methods used for statistical analysis, list of all outcomes examined, and the effect sizes/other pertinent statistical variables of outcomes pertaining to sleep or other mental health symptoms.

### 2.4. Comparators

We examined and compared the usage of weighted blankets to all possible comparators including but not limited to treatment as usual, other insomnia treatments, and placebo.

### 2.5. Quality assessment

Three authors (SW, BL, CS) independently assessed the quality of all included studies using the Cochrane Risk of Bias 2 tool for all RCTs (Sterne et al., 2019). The National Institute of Health (NIH) Quality Assessment Tool was used to assess the quality of all included cohort studies (National Heart, Lung, and Blood Institute, 2022). For the NIH Quality Assessment Tool, scores of 0–6 were considered "poor quality", 7–10 were "fair", and 11–14 were "good". All discrepancies were resolved through consensus.

### 2.6. Statistical analysis

Statistical analysis and meta-analysis was Comprehensive Meta-Analysis v4 (Borenstein et al., 2022).

Effect size was calculated by Cohen's *d*. Standardized mean difference (SMD) was used as a measure of effect in which an effect size of 0.2, 0.5, and 0.8 would be considered small, medium, and large respectively (Cohen, 1988). Hedge's g was also used to measure the effect size if the number of studies used to perform the meta-analysis was 20 or less (Hedges and Olkin, 2014). Inverse variance method was used to weight the pooled effect size, as measured with the random-effects model. Heterogeneity of the studies was assessed by calculating the $X^2$ and the $I^2$, where $p < 0.10$ and >35% was used as thresholds for heterogeneity, respectively (Higgins et al., 2003; Higgins and Thompson, 2002). Sensitivity analyses were performed by excluding one study at a time. Publication bias was assessed by using the funnel plot and the Egger's regression test (Egger et al., 1997).

## 3. Results

### 3.1. Search results

Our search strategy returned 235 abstracts. Of these, 35 articles were included for full-text review, and 9 studies were included for extraction (Supplementary Fig. 1). Reasons for exclusion from extraction included: duplicate full-text, no results available, no weighted blanket usage, no psychiatric participants, wrong study design, no reported sleep or mental health outcomes using a validated quantitative scale. These 9 studies contributed to a total sample size of 553 participants. There were 289 participants receiving weighted blanket intervention and 264 participants in the control group.

### 3.2. Study characteristics

Two studies had pediatric age participants (<18 years old) and the remaining studies had adult participants. Four studies reported those with mood disorders, 3 studies with a learning disability or developmental disorders, 3 studies with psychotic disorders, 2 studies with anxiety disorders, 1 study with major cognitive disorders, 1 study with substance use disorders, and 1 study with eating disorders. Within the sample, size, 112 participants had a diagnosis of a depressive disorder, 111 diagnosed with bipolar affective disorder (BAD) type I or II, 107 with ADHD, 67 with autism spectrum disorder (ASD), 31 with schizophrenia, 21 with anorexia nervosa (AN), 2 with avoid/restrictive food intake disorder, 20 with major cognitive disorder (MCD), 15 with schizoaffective disorder, 14 with an anxiety disorder, 4 with borderline personality disorder (BPD), 2 with a substance use disorder (SUD) that were not specified, and 30 with an another unspecified psychiatric disorder not specified by the authors (Table 1). One study had 30 adult mental health patients but did not specify diagnoses (Champagne et al., 2015).

All studies used weighted blankets as their form of deep pressure therapy intervention as part of their treatment. However, no study reported solely using weighted blankets as treatment for the psychiatric disorder. Three studies were performed in the United States, three in Sweden, and one each in Australia and the United Kingdom. Six studies were in adult psychiatric patients while two were in children (under age 18 years old). Among the 8 included studies, five were randomized controlled trials (RCT), three were non-randomized controlled studies, and one was a prospective cohort study (Table 1).

In terms of setting, five studies were conducted in the inpatient psychiatry setting (Becklund et al., 2021; Champagne et al., 2015; Ekholm et al., 2020; Novak et al., 2012; Ohene et al., 2022), 2 were in the outpatient setting (Gringras et al., 2014; Lönn et al., 2023b), and 1 was in the nursing home setting and emergency department respectively (Dickson et al., 2023; Harris and Titler, 2022). Lengths of intervention ranged from 5 months to 3 years with no study conducting follow-up. Length of interventions lasted from at least 5 min to nightly for one year. Three studies continued to follow-up with their participants up to a year (Ekholm et al., 2020; Gringras et al., 2014; Ohene et al., 2022).

### 3.3. Sleep outcomes

Four studies reported sleep outcomes with use of weighted blankets in patients with psychiatric disorders (Table 2). In studies measuring insomnia, Ekholm et al. (2020) reported improvements in insomnia symptoms as measured by the Insomnia Severity Index (ISI) in adult psychiatric inpatients (including BAD, GAD, recurrent depression, and ADHD) using weighted blankets (pre-ISI = 21.7; post-ISI = 9.2) compared to control groups using sham weighted blankets (pre-ISI = 21.2; post-ISI = 18.8) with a statistically significant difference ($p < 0.001$). In contrast, Lönn et al. (2023) found no statistical difference in ISI scores from weighted blanket use in children with ADHD when compared to sham blanket control (standardized mean difference (SMD) = $-0.71 \pm 4.36$, $p = 0.127$ between groups post intervention)).

In terms of total sleep time (TST) measured by actigraphy, Gringras et al. (2014) found no significant difference in TST in children with ASD using weighted blankets compared to the control group (WB-pre score = $454.4 \pm 62.4$; WB-post score = $452.8 \pm 65$ vs. Control-pre score = $457.7 \pm 64.6$; Control-post score = $455.5 \pm 65.8$, $p = 0.374$ between groups post intervention)). However, Lönn et al. (2023) found an increase in TST from weighted blanket use that was statistically significant in children with ADHD when compared to sham blanket control (SMD = $7.72 \pm 31.69$, $p = 0.027$ between groups post intervention)).

In terms of sleep onset latency (SOL) as measured by actigraphy, Gringras et al. (2014) found no statistical difference in SOL from weighted blanket use in children with ASD (WB-pre score = $74.3 \pm 48.7$; WB-post score = $71.4 \pm 48.2$ vs. Control-pre score = $69.9 \pm 43.8$; Control-post score = $70.6 \pm 44.3$, $p = 0.578$ between groups post intervention)). This was also observed in Lönn et al. (2023) in children with ADHD when compared to sham blanket control which also reported no significant statistical difference (SMD = $-1.74 \pm 20.29$, $p = 0.432$ between groups post intervention)).

Additionally, Harris (2022), reported improvements in the sleep domain of the Neuropsychiatric Inventory as reported by caregivers of

**Table 1**
Characteristics of included studies.

| Study | Country of author | Study design | Sample size (N) | Psychiatric disorder | Intervention | Control characteristics | Average age of participants | Study quality |
|---|---|---|---|---|---|---|---|---|
| Becklund et al., 2021 | United States | Non-randomized controlled trial | 122 | BAD (n = 45)<br>MDD (n = 48)<br>Schizoaffective (n = 14)<br>Schizophrenia (n = 5)<br>SUD (n = 2)<br>Other (n = 8) | Weighted blankets | No weighted blanket | 39.5 | Fair |
| Champagne 2015 | United States | Randomized controlled trial with cross-over design | 30 | Not specified | Weighted blankets | No weighted blankets initially | Not reported (age 18–65) | High risk |
| Dickson et al., 2023 | United States | Non-randomized controlled trial | 15 | Depression (n = 12)<br>Schizoaffective (n = 1)<br>Schizophrenia (n = 1)<br>Anxiety (n = 1) | Weighted blankets | No weighted blanket | 35.1 | Fair |
| Ekholm et al., 2020 | Sweden | Randomized controlled trial | 120 | BAD I (n = 14)<br>BAD II (n = 25)<br>BAD NOS (n = 9)<br>Recurrent depression (n = 46)<br>GAD (n = 13)<br>ADHD (n = 13) | Weighted blankets | Sham weighted blanket (unspecified) | 39.6 | Low risk |
| Gringras et al., 2014 | United Kingdom | Randomized controlled trial with cross-over design | 67 | Autism spectrum disorder | Weighted blankets | Sham weighted blanket (unspecified) | 9.33 ± 3.05 | Some concerns |
| Harris 2022 | United States | Prospective cohort study | 20 | Dementia and major cognitive disorders | Weighted blankets | N/A | 77.7 ± 10.2 | Fair |
| Lönn et al., 2023b | Sweden | Randomized controlled trial with cross-over design | 94 | ADHD | Weighted blankets | 2 kg sham weighted blankets | 9.0 ± 2.2 | Some concern |
| Novak et al., 2012 | Australia | Non-randomized controlled trial | 32 | Schizophrenia (n = 25)<br>BAD (n = 18)<br>MDD (n = 6)<br>BPD (n = 4)<br>Others (n = 22) | Weighted blankets | No weighted blanket | "adults" | Fair |
| Ohene et al., 2022 | United States | Randomized controlled trial | 23 | Anorexia nervosa (n = 21)<br>Avoidant/restrictive food intake disorder (n = 2) | Weighted blankets | No weighted blanket | 26.65 ± 10.13 | Some concern |

BAD = bipolar affective disorder, MDD = major depressive disorder, GAD = generalized anxiety disorder, SUD = substance use disorder, ADHD = attention deficit hyperactivity disorder, BPD = borderline personality disorder, NOS = not otherwise specified.

people with dementia and major cognitive disorders living in nursing homes (WB-pre score = 3.9 ± 2.9; WB-post score = 4.3 ± 3.7).

### 3.4. Mental health outcomes

Seven studies (3 RCT and 4 cohort studies) reported mental health outcomes from use of weighted blankets in patients with psychiatric disorders. All seven studies reported anxiety related outcomes while one study also reported on depression outcomes (Table 2). Becklund et al. (2021) used the State Trait Anxiety Inventory (STAI-Y6) and reported a decrease in anxiety scores from weighted blanket use in adult patients with psychiatric disorders(including those with BAD, MDD, schizoaffective, schizophrenia, and SUD) that was statistically significant compared to control (WB-pre score = 49.49 ± 16.98, WB-post score = 31.75 vs. Control-pre score = 43.24 ± 14.15; Control-post score = 49.19, $p < 0.001$ between groups post intervention)). Ekholm et al. (2020) also observed a decrease in Hospital Anxiety and Depression (HAD-A) anxiety score that was statistically significant from control (WB-pre score = 13.8; WB-post score = 10.3 vs. Control-pre score = 13.6; Control-post score = 12.9, $p < 0.001$ between groups post intervention)). Similarly, Novak et al. (2012) also reported a decrease in anxiety scores (using an unspecified 10-point scale) in psychiatric emergency room patients (including those with schizophrenia, BAD, MDD, and BPD) from weighted blanket use compared to control that was statistically significant (WB-pre score = 6 ± 2.1; WB-post score = 2.7 ± 2.3 vs. Control-pre score = 4.1 ± 2.4; Control-post score = 2.4 ± 1.8, p

**Table 2**
Summary of study sleep and mental health outcomes.

| Study | Sleep outcome measurement | Sleep outcomes | Mental health measurements | Mental health outcomes | Adverse events |
|---|---|---|---|---|---|
| Becklund et al., 2021 | N/A | N/A | STAI-Y6 | WB-pre score: 49.49 ± 16.98<br>WB-post score: 31.75 ± NR<br>Control-pre score: 43.24 ± 14.15<br>Control-post score: 49.19 ± 17.98 p-value[a]: <0.001 | N/A |
| Champagne 2015 | N/A | N/A | STAI-10 | WB-post score: 16.97<br>Control-post score: 19.10 p-value[a]: 0.164 | N/A |
| Dickson et al., 2023 | N/A | N/A | PROMIS (anxiety scale) | WB-pre score: 70.56 ± 6.73<br>WB-post score: 65.42 ± 9.22<br>Control-pre score: 67.7 ± 5.2<br>Control-post score: 65.6 ± 10.6<br>p-value[a]: Not reported | N/A |
| Ekholm et al., 2020 | ISI | WB-pre score: 21.7<br>WB-post score: 9.2<br>Control-pre score: 21.2<br>Control-post score: 18.8<br>P-value: <0.001 | HAD-Depression<br>HAD-Anxiety | HAD-Depression<br>WB-pre score: 10.5<br>WB-post score: 6.1<br>Control-pre score: 9.5<br>Control-post score: 8.9 p-value[a]: <0.001<br>HAD-Anxiety<br>WB-pre score: 13.8<br>WB-post score: 10.3<br>Control-pre score: 13.6<br>Control-post score: 12.9 p-value[a]: <0.001 | N/A |
| Gringras et al., 2014 | TST actigraphy<br>SOL actigraphy | TST<br>WB-pre score: 454.4 ± 62.4<br>WB-post score: 452.8 ± 65<br>Control-pre score: 457.7 ± 64.6<br>Control-post score: 455.5 ± 65.8<br>P-value: 0.374<br>SOL<br>WB-pre score: 74.3 ± 48.7<br>WB-post score: 71.4 ± 48.2<br>Control-pre score: 69.9 ± 43.8<br>Control-post score: 70.6 ± 44.3<br>P-value: 0.578 | N/A | N/A | 2-day skin rash on 1 child that may have been related to the blanket |
| Harris and Titler, 2022 | NPI sleep domain (reported by caregiver) | WB-pre score: 3.9 ± 2.9<br>WB-post score: 4.3 ± 3.7 | RAID-PWD<br>RAID-Caregiver | RAID-PWD<br>WB-pre score: 5.7 ± 5.8<br>WB-post score: 5.4 ± 4.8<br>RAID-Caregiver<br>WB-pre score: 9.7 ± 6<br>WB-post score: 7.7 ± 5 | N/A |
| Lönn et al., 2023b | SOL actigraphy<br>TST actigraphy<br>ISI | SOL<br>SMD = −1.74 ± 20.29<br>P-value: 0.432<br>TST<br>SMD = 7.72 ± 31.69<br>P-value: 0.027<br>ISI<br>SMD = −0.71 ± 4.36<br>P-value: 0.127 | N/A | N/A | Panic (n = 1)<br>Anxiety (n = 1)<br>Pain (n = 2) |
| Novak et al., 2012 | N/A | N/A | Anxiety (Unspecified 10-point scale) | WB-pre score: 6 ± 2.1<br>WB-post score: 2.7 ± 2.3<br>Control-pre score: 4.1 ± 2.4<br>Control-post score: 2.4 ± 1.8 p-value[a]: 0.03 | N/A |
| Ohene et al., 2022 | N/A | N/A | Beck Anxiety Inventory | WB-pre score: 34.4 ± 8.9<br>WB-post score: 24.8 ± 10.6<br>Control-pre score: 36.9 ± 8.1<br>Control-post score: 28.7 ± 10.6<br>p-value[a]: 0.83<br>SMD = −1.21<br>95% CI = (−18.4,15.9) | N/A |

N/A = not applicable, SOL = sleep onset latency, TST = total sleep time, ISI = Insomnia Severity Index, SMD = standardized mean difference, NPI = neuropsychiatric inventory, WB = weighted blanket, STAI-Y6 = State Trait Anxiety Inventory, PROMIS = Patient-Reported Outcomes Measurement Information System, HAD = Hospital Anxiety and Depression Scale, RAID = Rating Anxiety in Dementia Scale, PWD = person with dementia, NR = not reported.

[a] p-values were for the differences between post-intervention scores between weighted blanket groups and control groups.

= 0.03 between groups post intervention)).

Dickson et al. (2023) reported that emergency room psychiatric patients reported a decrease in anxiety as measured on the Patient-Reported Outcomes Measurement Information System (PROMIS) anxiety scale compared to control (WB-pre score = 70.56 ± 6.73; WB-post score = 65.42 ± 9.22 vs. Control-pre score: 67.7 ± 5.2; Control-post score = 65.6 ± 10.6, p not reported). Harris (2022) also found a decrease in self-reported and caregiver observed levels of anxiety in nursing home patients with dementia and MCD.

In contrast, Ohene et al. (2022) reported a non-significant decrease in anxiety scores from weighted blanket use in AN and ARFID patients compared to control sham blankets (WB-pre score = 34.4 ± 8.9; WB-post score = 24.8 ± 10.6 vs. Control-pre score = 36.9 ± 8.1; Control-post score = 28.7 ± 10.6, p = 0.83 between groups post intervention). Similarly, Champagne et al. (2015) found a decrease in anxiety scores on STAI-10 by 60% after weighted blanket use. However, this was not statistically significant (WB = 16.97 vs. control = 19.10, p = 0.164).

In terms of depressive symptoms, Ekholm et al. (2020) found a statistically significant decrease in HAD depression (HAD-D) scales after weighted blanket use that was statistically different from control (WB-pre score = 10.5; WB-post score = 6.1 vs. Control-pre score = 9.5; Control-post score = 8.9, p < 0.001 between groups post intervention)).

### 3.5. Adverse events

Two studies reported adverse events from the use of weighted blankets. Gringras et al. (2014) reported a two-day skin rash in a child that may have been related to the blanket within a sample of 67 children. Lönn et al. (2023) reported panic in one child, anxiety in one child, and pain in two children from weighted blanket usage among their sample of 94 children.

### 3.6. Quantitative synthesis

Due to the limited number of studies reporting similar sleep outcomes, quantitative analysis was not possible at this time.

Patients with psychiatric disorders had improved symptoms of anxiety when using a weighted blanket compared to those without or using a sham blanket (SMD = −0.47, 95% CI: −0.68 to −0.25, p < 0.001) (Fig. 1). Using Hedge's g did not change outcomes (SMD = −0.45, 95% CI: −0.67 to −0.23, p < 0.001). Heterogeneity was not significant ($I^2$ = 4.2%, p = 0.390). Sensitivity analysis showed that two studies were responsible for the significance (p > 0.001) Ekholm et al. (2020) and Becklund (2021) with p-values of 0.004 and 0.005 respectively. For publication bias, the funnel plot showed asymmetry with no studies outside of the margins (Supplementary Fig. 4). Egger's test was not significant for publication bias (p = 0.052).

### 3.7. Quality assessment

Five RCTs were assessed using the Cochrane's Risk of Bias Tool 2 (Sterne et al., 2019) (Supplementary Table 2). In terms of the random sequence process, four studies had low risk of bias during the randomization process with 1 RCT showing some concern. In terms of deviation from intended interventions, four studies had some concerns of bias with one low risk. All studies were low risk of vias due to missing outcome data. Four RCT had some concern of bias in measurement of outcome while one was low risk. Four RCTs were low risk of bias in selection of reported results with one showing some concern of bias. Overall, one was low risk of bias, 3 had some concerns of bias, and 1 had high risk of bias (Supplementary Table 2).

Four Non-RCT studies were assessed using the NIH Quality Assessment tool (Study Quality Assessment Tools | NHLBI, NIH, n.d.) (Supplementary Table 3). Three studies had a clearly stated research question or objective. Most notably, no study repeated exposures more than once over time, statistically adjusted for the impact of confounding variables on the relationship between exposures and outcomes, or had blinding of assessors to the exposure status of the participants. Overall, three studies were considered "fair" in quality and 1 was "poor" quality (Supplementary Table 3).

## 4. Discussion

The aim of this study was to synthesize the current evidence on the effects of weighted blankets on patients with psychiatric disorders with regards to their sleep and mental health related symptoms. The results of this review suggest that weighted blankets may improve total sleep time and reduce the severity of insomnia in psychiatric patients. However,

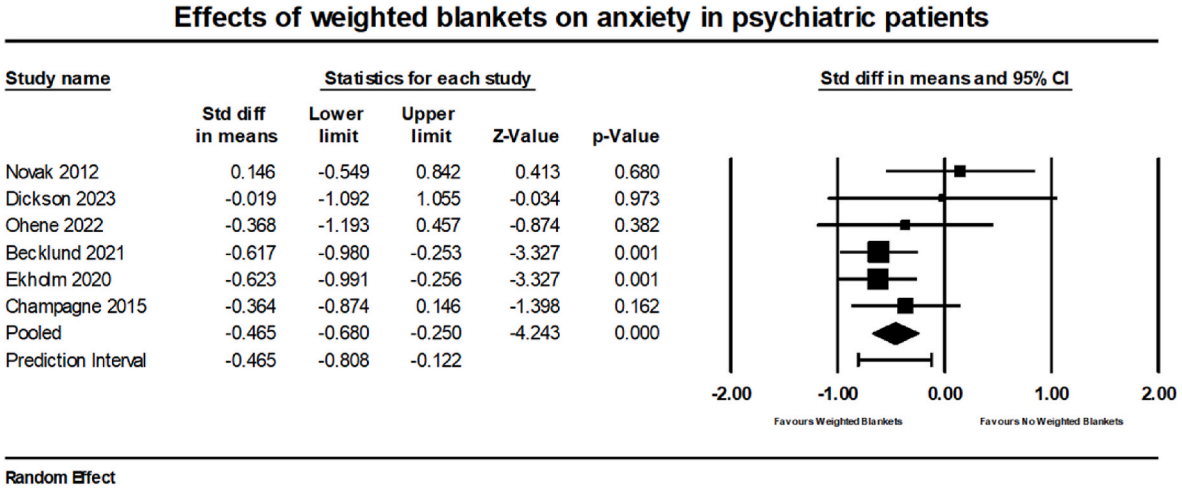


**Fig. 1.** Forest plot examining the usage of weighted blankets on symptoms of anxiety in psychiatric patients. "Favors Weighted Blankets" indicates better improvement in anxiety symptoms in patients with a psychiatric disorder using a weighted blanket and "Favors Placebo" indicates better improvement in anxiety symptoms in patients without usage of a weighted blanket.

there is a lack of sufficient enough studies in this population to allow for meta-analysis. In regards to the effects of weighted blankets on mental health symptoms in psychiatric patients, our meta-analysis showed that when compared to no weighted blanket usage, people with psychiatric disorders who use weighted blankets have improvements in their anxiety symptoms that are statistically significant. To our knowledge, the current systematic review is the first to synthesize evidence on the use of weighted blankets in patients with psychiatric disorders. Given the known links between sleep and mental health including depression, ADHD, and even suicidal behavior, it is important to find interventions that can improve sleep in psychiatric patients (Becker et al., 2014, 2018; Boland et al., 2023; Palagini et al., 2022).

Additionally, there was a lack of high quality studies that were conducted as most studies were fair or had some methodological concerns. Similar to our results, a systematic review by Eron et al. (2020) which evaluated the use of weighted blankets in the general population reported that weighted blankets can help with reducing anxiety but have limited evidence for improving insomnia (Eron et al., 2020). However, due to significant heterogeneity in the studies reviewed, meta-analysis was not completed for their review. The current review identified only a few adverse events from use of weighted blankets in pediatric populations. Given the non-invasive nature of weighted blankets, they are generally considered well tolerated and safe.

The mechanism by which weighted blankets may benefit anxiety is not well understood. It has been suggested that weighted blankets provide a form of deep pressure therapy evenly across the body, similar to the sensation of a hug. This effect may cause activation of the parasympathetic nervous system resulting in lowering of heart rate, blood pressure, and decrease in blood cortisol levels (Dueren et al., 2022; Sumioka et al., 2013). For example, when investigating the usage of deep pressure stimulation via weighted blankets on healthy undergraduate student volunteers, previous studies have reported a 33% reduction in electrodermal activity (EDA) which was used to measure sympathetic activity (Mullen et al., 2008). It was also reported that 63% of participants experienced a reduction in their anxiety symptoms as measured by the STAI-10 (Mullen et al., 2008). Similarly, another study reported a reduction in autonomic activation via EDA and dental anxiety scores when using weighted blankets in dental patients without a psychiatric disorder undergoing procedures (Chi, 2013).

The increase in parasympathetic activation and decrease in sympathetic activation could physiologically play a role in aiding with sleep (Lönn et al., 2023). Additionally, deep pressure stimulation can strengthen cues for sleep by reducing stimuli from other distractions, priming the sensation of the weighted blanket with sleep, and improving sleep routines (Lönn et al., 2023). However, as reported in the current review, evidence for the efficacy of weighted blankets as a sleep aid in psychiatric patients remains unknown.

While not included in this systematic review, the evidence on the impact of weighted blankets on sleep medication usage is also conflicting. A previous study reported decreased sleep medication use (aside from melatonin use which was increased) in adults with a psychiatric disorder. However, another study reported no association between weighted blanket use and decreased sleep medication use in children with sleep disturbances (Cederlund et al., 2023).

The broad search criteria and a meta-analysis of the most up-to-date literature is a strength of the present review. Our results must be interpreted within their limitations. First, although there were multiple studies investigating the usage of weighted blankets in psychiatric patients, there was heterogeneity in the measurement and reporting of both sleep and mental health outcomes. However, statistically the heterogeneity was found to not be significantly impacting the meta-analysis. Secondly, the inclusion of cohort studies limits our ability to establish causality. However, due to the limited literature on weighted blankets, non-RCT studies were included to perform a comprehensive review on this topic. Third, the small sample sizes of the studies performed to date have lower power when establishing efficacy of weighted blanket treatment. More higher quality studies are required. Future studies with larger sample sizes, RCT study design, different clinical settings, and longitudinal follow-up will allow us to further understand the effects of the use of weighted blankets in patients with psychiatric disorders.

## 5. Conclusion

Sleep plays an important role in mental health and well-being. Our systematic review presented a synthesis of evidence for the use of weighted blankets in psychiatric patients as a non-pharmacological approach in improving sleep. Additionally, our meta-analysis showed improvements in anxiety symptoms with weighted blanket use compared to control groups. However, the literature is limited by heterogenous outcome reporting, small number of RCTs, and small sample sizes. More higher quality research studies are required in this field. Future studies addressing these limitations will contribute to further elucidating the effect of weighted blankets in patients with psychiatric disorders.

## Data availability

The dataset underlying this article will be shared on reasonable request to the corresponding author.

## CRediT authorship contribution statement

**Stanley Wong:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nicholas Fabiano:** Writing – review & editing, Data curation. **Brandon Luu:** Writing – review & editing, Data curation. **Chanhee Seo:** Writing – review & editing, Data curation. **Arnav Gupta:** Writing – review & editing, Data curation. **Helena K. Kim:** Writing – review & editing, Methodology. **Risa Shorr:** Methodology. **Brett D.M. Jones:** Writing – review & editing, Methodology. **Michael S.B. Mak:** Writing – review & editing, Conceptualization. **M. Ishrat Husain:** Writing – review & editing, Supervision, Methodology, Conceptualization.

## Declaration of competing interest

**SW, NF, BL, CS, AG, HK, RS, and BJ** have no disclosures or conflicts of interest to declare. **MIH** receives research support from the Brain and Behavior Research Foundation, Canadian Institutes of Health Research (CIHR), CAMH Foundation, Grand Challenges Canada, the PSI Foundation, and the University of Toronto. He has provided consultancy to Mindset Pharma, PsychEd Therapeutics, and Wake Network. **MM** receives unrestricted education grants from Paladin Labs, Eisai, and Jazz Pharmaceuticals. He has received speaker's honoraria from Eisai and Sunovion. He has provided consultancy to Idorisa, Eisai, and Jazz Pharmaceuticals.

## Acknowledgements

None.

## Glossary

| | |
|---|---|
| **ADHD** | attention deficit and hyperactivity disorder |
| **AN** | anorexia nervosa |
| **ARFID** | avoidant restrictive food intake disorder |
| **ASD** | autism spectrum disorder |
| **BAD** | bipolar affective disorder |
| **BPD** | borderline personality disorder |
| **CBT-I** | cognitive behavioral therapy for insomnia |
| **DSM** | Diagnostic and Statistical Manual of Mental Disorders |

| | |
|---|---|
| **DTP** | deep touch pressure |
| **HAD** | Hospital Anxiety and Depression Anxiety |
| **ICD** | International Classification of Diseases |
| **ISI** | insomnia severity index |
| **MCD** | major cognitive disorder |
| **NIH** | National Institute of Health |
| **MDD** | major depressive disorder |
| **OT** | occupational therapy |
| **PRISMA** | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| **PROMIS** | Patient-Reported Outcomes Measurement Information System |
| **PTSD** | post-traumatic stress disorder |
| **RCT** | Randomized controlled trial |
| **SMD** | standardized mean difference |
| **SOL** | sleep onset latency |
| **SUD** | substance use disorder |
| **STAI** | State Trait Anxiety Inventory |
| **TST** | total sleep time |
| **WB** | weighted blanket |

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2024.09.027.

## References


Ackerley, R., Badre, G., Olausson, H., 2015. Positive effects of a weighted blanket on insomnia. Journal of Sleep Medicine & Disorders 2 (3), 1–7.

Baglioni, C., Nanovska, S., Regen, W., Spiegelhalder, K., Feige, B., Nissen, C., Reynolds III, C.F., Riemann, D., 2016. Sleep and mental disorders: a meta-analysis of polysomnographic research. Psychol. Bull. 142 (9), 969–990. https://doi.org/10.1037/bul0000053.

Becker, S.P., Dvorsky, M.R., Holdaway, A.S., Luebbe, A.M., 2018. Sleep problems and suicidal behaviors in college students. J. Psychiatr. Res. 99, 122–128. https://doi.org/10.1016/j.jpsychires.2018.01.009.

Becker, S.P., Luebbe, A.M., Langberg, J.M., 2014. Attention-deficit/hyperactivity disorder dimensions and sluggish cognitive tempo symptoms in relation to college students' sleep functioning. Child Psychiatr. Hum. Dev. 45 (6), 675–685. https://doi.org/10.1007/s10578-014-0436-8.

Becker, S.P., Sidol, C.A., Van Dyk, T.R., Epstein, J.N., Beebe, D.W., 2017. Intraindividual variability of sleep/wake patterns in relation to child and adolescent functioning: a systematic review. Sleep Med. Rev. 34, 94–121. https://doi.org/10.1016/j.smrv.2016.07.004.

Becker, S.P., Willcutt, E.G., Leopold, D.R., Fredrick, J.W., Smith, Z.R., Jacobson, L.A., Burns, G.L., Mayes, S.D., Waschbusch, D.A., Froehlich, T.E., McBurnett, K., Servera, M., Barkley, R.A., 2023. Report of a work group on sluggish cognitive tempo: key research directions and a consensus change in terminology to cognitive disengagement syndrome. Journal of the American Academy of Child & Adolescent Psychiatry 62 (6), 629–645. https://doi.org/10.1016/j.jaac.2022.07.821.

Becklund, A.L., Rapp-McCall, L., Nudo, J., 2021. Using weighted blankets in an inpatient mental health hospital to decrease anxiety. Journal of Integrative Medicine 19 (2), 129–134. https://doi.org/10.1016/j.joim.2020.11.004.

Ben Simon, E., Walker, M.P., 2018. Sleep loss causes social withdrawal and loneliness. Nat. Commun. 9 (1), 3146. https://doi.org/10.1038/s41467-018-05377-0.

Boland, E.M., Goldschmied, J.R., Gehrman, P.R., 2023. Does insomnia treatment prevent depression? Sleep 46 (6), zsad104. https://doi.org/10.1093/sleep/zsad104.

Borenstein, M., Hedges, L., Higgins, J., Rothstein, H., 2022. Comprehensive meta-analysis version 4 (version 4). Biostat [Computer software].

Burns, G.L., Becker, S.P., 2021. Sluggish cognitive tempo and ADHD symptoms in a nationally representative sample of U.S. Children: differentiation using categorical and dimensional approaches. J. Clin. Child Adolesc. Psychol. 50 (2), 267–280. https://doi.org/10.1080/15374416.2019.1678165. The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53.

Cederlund, M., Steingrimsson, S., Odéus, E., Nyström, K., Helgesson, C., Sondell, J.K., Franzén, S., Opheim, A., 2023. The introduction of a weighted blanket was not associated with a reduced collection of pharmaceuticals prescribed for sleep disturbances in children: a register-based study. Sleep Med. 105, 32–35. https://doi.org/10.1016/j.sleep.2023.03.001.

Champagne, T., Mullen, B., Dickson, D., Krishnamurty, S., 2015. Evaluating the safety and effectiveness of the weighted blanket with adults during an inpatient mental health hospitalization. Occup. Ther. Ment. Health 31 (3), 211–233. https://doi.org/10.1080/0164212X.2015.1066220.

Chennaoui, M., Arnal, P.J., Sauvet, F., Léger, D., 2015. Sleep and exercise: a reciprocal issue? Sleep Med. Rev. 20, 59–72. https://doi.org/10.1016/j.smrv.2014.06.008.

Chi, H.-J., 2013. Physiological effects of deep touch pressure on anxiety alleviation: the weighted blanket approach. J. Med. Biol. Eng. 33 (5), 463–470. https://www.academia.edu/70620938/Physiological_Effects_of_Deep_Touch_Pressure_on_Anxiety_Alleviation_The_Weighted_Blanket_Approach.

Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences, second ed. Routledge. https://doi.org/10.4324/9780203771587.

Cortese, S., Angriman, M., 2017. Treatment of sleep disorders in youth with ADHD: what is the evidence from randomised controlled trials and how should the field move forward? Expert Rev. Neurother. 17 (6), 525–527. https://doi.org/10.1080/14737175.2017.1311789.

Cortese, S., Sabé, M., Chen, C., Perroud, N., Solmi, M., 2022. Half a century of research on Attention-Deficit/Hyperactivity Disorder: a scientometric study. Neurosci. Biobehav. Rev. 140, 104769. https://doi.org/10.1016/j.neubiorev.2022.104769.

Díaz-Román, A., Mitchell, R., Cortese, S., 2018. Sleep in adults with ADHD: systematic review and meta-analysis of subjective and objective studies. Neurosci. Biobehav. Rev. 89, 61–71. https://doi.org/10.1016/j.neubiorev.2018.02.014.

Dickson, D.A., Gantt, L., Swanson, M., 2023. Effectiveness of the weighted blanket with psychiatric patients in the emergency department: a pilot study. J. Am. Psychiatr. Nurses Assoc. 29 (4), 307–313. https://doi.org/10.1177/10783903211026740.

Dueren, A.L., Perach, R., Banissy, J.F.M., Bowling, N.C., Gregory, A.M., Banissy, M.J., 2022. Associations between tactile intimacy and sleep quality in healthy adults: a systematic review. Journal of Sleep Research 31 (3), e13504. https://doi.org/10.1111/jsr.13504.

Egger, M., Davey Smith, G., Schneider, M., Minder, C., 1997. Bias in meta-analysis detected by a simple, graphical test. Br. Med. J. 315 (7109), 629–634. https://doi.org/10.1136/bmj.315.7109.629.

Ekholm, B., Spulber, S., Adler, M., 2020. A randomized controlled study of weighted chain blankets for insomnia in psychiatric disorders. J. Clin. Sleep Med. 16 (9), 1567–1577. https://doi.org/10.5664/jcsm.8636.

Eron, K., Kohnert, L., Watters, A., Logan, C., Weisner-Rose, M., Mehler, P.S., 2020. Weighted blanket use: a systematic review. Am. J. Occup. Ther. 74 (2), 7402205010p1. https://doi.org/10.5014/ajot.2020.037358, 7402205010p.14.

Freeman, D., Sheaves, B., Waite, F., Harvey, A.G., Harrison, P.J., 2020. Sleep disturbance and psychiatric disorders. Lancet Psychiatr. 7 (7), 628–637. https://doi.org/10.1016/S2215-0366(20)30136-X.

Gangwisch, J.E., Babiss, L.A., Malaspina, D., Turner, J.B., Zammit, G.K., Posner, K., 2010. Earlier parental set bedtimes as a protective factor against depression and suicidal ideation. Sleep 33 (1), 97–106. https://doi.org/10.1093/sleep/33.1.97.

Gee, B., Orchard, F., Clarke, E., Joy, A., Clarke, T., Reynolds, S., 2019. The effect of non-pharmacological sleep interventions on depression symptoms: a meta-analysis of randomised controlled trials. Sleep Med. Rev. 43, 118–128. https://doi.org/10.1016/j.smrv.2018.09.004.

Goldstein, A.N., Walker, M.P., 2014. The role of sleep in emotional brain function. Annu. Rev. Clin. Psychol. 10, 679–708. https://doi.org/10.1146/annurev-clinpsy-032813-153716.

Grandin, T., 1992. Calming effects of deep touch pressure in patients with autistic disorder, college students, and animals. J. Child Adolesc. Psychopharmacol. 2 (1), 63–72. https://doi.org/10.1089/cap.1992.2.63.

Green, L., Willis, E., Ziev, N., Oliveira, D., Kornblau, B., Robertson, S., 2020. The impact of weighted blankets on the sleep and sensory experiences of autistic adults. AJOT: Am. J. Occup. Ther. 74 (S1). NA-NA.

Gringras, P., Green, D., Wright, B., Rush, C., Sparrowhawk, M., Pratt, K., Allgar, V., Hooke, N., Moore, D., Zaiwalla, Z., Wiggs, L., 2014. Weighted blankets and sleep in autistic children—a randomized controlled trial. Pediatrics 134 (2), 298–306. https://doi.org/10.1542/peds.2013-4285.

Hanć, T., Cortese, S., 2018. Attention deficit/hyperactivity-disorder and obesity: a review and model of current hypotheses explaining their comorbidity. Neurosci. Biobehav. Rev. 92, 16–28. https://doi.org/10.1016/j.neubiorev.2018.05.017.

Harris, M.L., Titler, M.G., 2022. Feasibility and acceptability of a remotely delivered weighted blanket intervention for people living with dementia and their family caregivers. J. Appl. Gerontol. 41 (11), 2316–2328. https://doi.org/10.1177/07334648221111123.

Hedges, L.V., Olkin, I., 2014. Statistical Methods for Meta-Analysis. Academic Press.

Hertenstein, E., Feige, B., Gmeiner, T., Kienzler, C., Spiegelhalder, K., Johann, A., Jansson-Fröjmark, M., Palagini, L., Rücker, G., Riemann, D., Baglioni, C., 2019. Insomnia as a predictor of mental disorders: a systematic review and meta-analysis. Sleep Med. Rev. 43, 96–105. https://doi.org/10.1016/j.smrv.2018.10.006.

Higgins, J.P.T., Thompson, S.G., 2002. Quantifying heterogeneity in a meta-analysis. Stat. Med. 21 (11), 1539–1558. https://doi.org/10.1002/sim.1186.

Higgins, J.P.T., Thompson, S.G., Deeks, J.J., Altman, D.G., 2003. Measuring inconsistency in meta-analyses. Br. Med. J. 327 (7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557.

Hjort Telhede, E., Arvidsson, S., Karlsson, S., Ivarsson, A., 2022. Weighted blankets' effect on the health of older people living in nursing homes. Geriatrics 7 (4). https://doi.org/10.3390/geriatrics7040079. Article 4.

Kahn, M., Sheppes, G., Sadeh, A., 2013. Sleep and emotions: bidirectional links and underlying mechanisms. Int. J. Psychophysiol. 89 (2), 218–228. https://doi.org/10.1016/j.ijpsycho.2013.05.010.

Kalak, N., Gerber, M., Kirov, R., Mikoteit, T., Yordanova, J., Pühse, U., Holsboer-Trachsler, E., Brand, S., 2012. Daily morning running for 3 weeks improved sleep and psychological functioning in healthy adolescents compared with controls. The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine 51 (6), 615–622. https://doi.org/10.1016/j.jadohealth.2012.02.020.

Kanji, S., Mera, A., Hutton, B., Burry, L., Rosenberg, E., MacDonald, E., Luks, V., 2016. Pharmacological interventions to improve sleep in hospitalised adults: a systematic review. BMJ Open 6 (7), e012108. https://doi.org/10.1136/bmjopen-2016-012108.

Konofal, E., Lecendreux, M., Cortese, S., 2010. Sleep and ADHD. Sleep Med. 11 (7), 652–658. https://doi.org/10.1016/j.sleep.2010.02.012.
Kredlow, M.A., Capozzoli, M.C., Hearon, B.A., Calkins, A.W., Otto, M.W., 2015. The effects of physical activity on sleep: a meta-analytic review. J. Behav. Med. 38 (3), 427–449. https://doi.org/10.1007/s10865-015-9617-6.
Langberg, J.M., Becker, S.P., Dvorsky, M.R., 2014. The association between sluggish cognitive tempo and academic functioning in youth with attention-deficit/hyperactivity disorder (ADHD). J. Abnorm. Child Psychol. 42 (1), 91–103. https://doi.org/10.1007/s10802-013-9722-3.
Lecendreux, M., Cortese, S., 2007. Sleep problems associated with ADHD: a review of current therapeutic options and recommendations for the future. Expert Rev. Neurother. 7 (12), 1799–1806. https://doi.org/10.1586/14737175.7.12.1799.
Lönn, M., Aili, K., Svedberg, P., Nygren, J., Jarbin, H., Larsson, I., 2023a. Experiences of using weighted blankets among children with ADHD and sleeping difficulties. Occup. Ther. Int. 2023, e1945290. https://doi.org/10.1155/2023/1945290.
Lönn, M., Svedberg, P., Nygren, J., Jarbin, H., Aili, K., Larsson, I., 2023b. The efficacy of weighted blankets for sleep in children with attention-deficit/hyperactivity disorder—a randomized controlled crossover trial. Journal of Sleep Research e13990. https://doi.org/10.1111/jsr.13990.
Miller, M.A., Renn, B.N., Chu, F., Torrence, N., 2019. Sleepless in the hospital: a systematic review of non-pharmacological sleep interventions. Gen. Hosp. Psychiatr. 59, 58–66. https://doi.org/10.1016/j.genhosppsych.2019.05.006.
Montgomery, P., Dennis, J., 2004. A systematic review of non-pharmacological therapies for sleep problems in later life. Sleep Med. Rev. 8 (1), 47–62. https://doi.org/10.1016/S1087-0792(03)00026-1.
Mullen, B., Champagne, T., Krishnamurty, S., Dickson, D., Gao, R.X., 2008. Exploring the safety and therapeutic effects of deep pressure stimulation using a weighted blanket. Occup. Ther. Ment. Health 24 (1), 65–89. https://doi.org/10.1300/J004v24n01_05.
Novak, T., Scanlan, J., McCaul, D., MacDonald, N., Clarke, T., 2012. Pilot study of a sensory room in an acute inpatient psychiatric unit. Australas. Psychiatr. 20 (5), 401–406. https://doi.org/10.1177/1039856212459585.
Ohene, R., Logan, C., Loresto, F., Watters, A., Eron, K., Markovchick, T., Mehler, P.S., 2022. Assessing the impact of weighted blankets on anxiety among patients with anorexia nervosa and avoidant– restrictive food intake disorder: a randomized controlled trial. Am. J. Occup. Ther. 76 (6), 7606205100. https://doi.org/10.5014/ajot.2022.049295.
Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., et al., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 372, n71. https://doi.org/10.1136/bmj.n71.
Palagini, L., Baglioni, C., Ciapparelli, A., Gemignani, A., Riemann, D., 2013. REM sleep dysregulation in depression: State of the art. Sleep Med. Rev. 17 (5), 377–390. https://doi.org/10.1016/j.smrv.2012.11.001.
Palagini, L., Hertenstein, E., Riemann, D., Nissen, C., 2022. Sleep, insomnia and mental health. Journal of Sleep Research 31 (4), e13628. https://doi.org/10.1111/jsr.13628.
Rasch, B., Born, J., 2013. About sleep's role in memory. Physiol. Rev. 93 (2), 681–766. https://doi.org/10.1152/physrev.00032.2012.
Rios, P., Cardoso, R., Morra, D., Nincic, V., Goodarzi, Z., Farah, B., Harricharan, S., Morin, C.M., Leech, J., Straus, S.E., Tricco, A.C., 2019. Comparative effectiveness and safety of pharmacological and non-pharmacological interventions for insomnia: an overview of reviews. Syst. Rev. 8 (1), 281. https://doi.org/10.1186/s13643-019-1163-9.
Sadeghi-Bahmani, D., Brand, S., 2022. Sleep patterns, sluggish cognitive tempo, and daytime sleepiness—A commentary on Fredrick et al. (2022). J. Child Psychol. Psychiatry Allied Discip. 63 (12), 1668–1670. https://doi.org/10.1111/jcpp.13693.
Sadeghi-Bahmani, D., Mohammadian, Y., Ghasemi, M., Bahmani, L.S., Piri, N., Brühl, A. B., Becker, S.P., Burns, G.L., Brand, S., 2022. Sluggish cognitive tempo among Iranian children and adolescents: a validation study of the farsi child and adolescent behavior inventory (CABI)–Parent version. J. Clin. Med. 11 (21), 6346. https://doi.org/10.3390/jcm11216346.
Sadeghi-Bahmani, D., Parhoon, H., Esmaeili, M., Parhoon, K., Sadeghi Bahmani, L., Khazaie, H., Becker, S.P., Burns, G.L., Brand, S., 2023. Validation of the farsi version of the adult concentration inventory for assessing cognitive disengagement syndrome. J. Clin. Med. 12 (14), 4607. https://doi.org/10.3390/jcm12144607.
Schroeck, J.L., Ford, J., Conway, E.L., Kurtzhalts, K.E., Gee, M.E., Vollmer, K.A., Mergenhagen, K.A., 2016. Review of safety and efficacy of sleep medicines in older adults. Clin. Therapeut. 38 (11), 2340–2372. https://doi.org/10.1016/j.clinthera.2016.09.010.
Sharafkhaneh, A., Salari, N., Khazaie, S., Ghasemi, H., Darvishi, N., Hosseinian-Far, A., Mohammadi, M., Khazaie, H., 2022. Telemedicine and insomnia: a comprehensive systematic review and meta-analysis. Sleep Med. 90, 117–130. https://doi.org/10.1016/j.sleep.2022.01.016.
Smith, Z.R., Eadeh, H.-M., Breaux, R.P., Langberg, J.M., 2019. Sleepy, sluggish, worried, or down? The distinction between self-reported sluggish cognitive tempo, daytime sleepiness, and internalizing symptoms in youth with attention-deficit/hyperactivity disorder. Psychol. Assess. 31 (3), 365–375. https://doi.org/10.1037/pas0000671.
Smith, Z.R., Zald, D.H., Lahey, B.B., 2020. Sluggish cognitive tempo and depressive symptoms in children and adolescents predict adulthood psychopathology. J. Abnorm. Child Psychol. 48 (12), 1591–1601. https://doi.org/10.1007/s10802-020-00692-x.
Staines, A.C., Broomfield, N., Pass, L., Orchard, F., Bridges, J., 2022. Do non-pharmacological sleep interventions affect anxiety symptoms? A meta-analysis. Journal of Sleep Research 31 (1), e13451. https://doi.org/10.1111/jsr.13451.
Sterne, J.A.C., Savović, J., Page, M.J., Elbers, R.G., Blencowe, N.S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M.S., Eldridge, S.M., Emberson, J.R., Hernán, M.A., Hopewell, S., Hróbjartsson, A., Junqueira, D.R., Jüni, P., Kirkham, J.J., Lasserson, T., Li, T., et al., 2019. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ l4898. https://doi.org/10.1136/bmj.l4898.
Study Quality Assessment Tools | NHLBI, NIH. (n.d.). Retrieved October 10, 2022, from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools.
Sumioka, H., Nakae, A., Kanai, R., Ishiguro, H., 2013. Huggable communication medium decreases cortisol levels. Sci. Rep. 3 (1). https://doi.org/10.1038/srep03034. Article 1.
Sys, J., Van Cleynenbreugel, S., Deschodt, M., Van der Linden, L., Tournoy, J., 2020. Efficacy and safety of non-benzodiazepine and non-Z-drug hypnotic medication for insomnia in older people: a systematic literature review. Eur. J. Clin. Pharmacol. 76 (3), 363–381. https://doi.org/10.1007/s00228-019-02812-z.
van der Helm, E., Gujar, N., Walker, M.P., 2010. Sleep deprivation impairs the accurate recognition of human emotions. Sleep 33 (3), 335–342. https://doi.org/10.1093/sleep/33.3.335.
van Straten, A., van der Zweerde, T., Kleiboer, A., Cuijpers, P., Morin, C.M., Lancee, J., 2018. Cognitive and behavioral therapies in the treatment of insomnia: a meta-analysis. Sleep Med. Rev. 38, 3–16. https://doi.org/10.1016/j.smrv.2017.02.001.
Veritas Health Innovation. (n.d.). Comput. Software. Retrieved December 1, 2022, from www.covidence.org.
Yang, Y., Luo, X., Paudel, D., Zhang, J., Li, S., Zhang, B., 2019. Effects of e-aid cognitive behavioural therapy for insomnia (eCBTI) to prevent the transition from episodic insomnia to persistent insomnia: study protocol for a randomised controlled trial. BMJ Open 9, e033457. https://doi.org/10.1136/bmjopen-2019-033457.
Zhu, Y., Stephenson, C., Moghimi, E., Jagayat, J., Nikjoo, N., Kumar, A., Shirazi, A., Patel, C., Omrani, M., Alavi, N., 2023. Investigating the effectiveness of electronically delivered cognitive behavioural therapy (e-CBTi) compared to pharmaceutical interventions in treating insomnia: protocol for a randomized controlled trial. PLoS One 18 (5), e0285757. https://doi.org/10.1371/journal.pone.0285757.