Clinical Psychology Review 114 (2024) 102503

Contents lists available at ScienceDirect

Clinical Psychology Review

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

Review

Sleep and paranoia: A systematic review and meta-analysis

Poppy Brown [a,*], Sarah Reeve [b,c], Matthew Hotton [a], Natalie Steer [a], Craig Steel [a]

[a] Oxford Institute of Clinical Psychology Training and Research, Oxford Health NHS Foundation Trust, Warneford Hospital, Warneford Lane, Oxford OX3 7JX, United Kingdom
[b] Norwich Medical School, University of East Anglia, Norwich NR4 7TJ, United Kingdom
[c] Cambridgeshire and Peterborough NHS Foundation Trust, Cambridge CB21 5EF, United Kingdom

ARTICLE INFO

Keywords:
Insomnia
Sleep-dysfunction
Paranoia
Psychosis
Persecutory delusions
Review

ABSTRACT

Background: Sleep dysfunction commonly co-occurs with paranoia and is hypothesised to be a contributory causal mechanism in its development and maintenance.
Objectives: To systematically review and quantitatively evaluate the evidence for the relationship between sleep dysfunction and paranoia across the spectrum of severity.
Method: A systematic search was conducted to identify studies investigating the relationship between aspects of sleep and paranoia across clinical and non-clinical groups. A random effects model using a Fisher r-to-z transformed correlation coefficient was used for meta-analysis.
Results: 45 studies were included in the review and 14 in the meta-analysis. The literature supports a small-to-moderate association (r = 0.30, 95 % CI: 0.16–0.40 for the seven studies using the most robust measures) with significant heterogeneity among studies but no evidence of publication bias. There is evidence that the relationship is to some extent causal, with sleep disruption leading to increased paranoia, though there is also some evidence of a bi-directional relationship. Negative affect is frequently seen as a mediator of this relationship.
Conclusion: This review for the first time examines the significant relationship between sleep and paranoia individually. Studies are needed that further assess the potential for early intervention of sleep dysfunction in those experiencing paranoia.

1. Introduction

Sleep disturbance has long been recognised as a common occurrence in those experiencing psychosis, ever since schizophrenia was first clinically described by early psychiatrists Kraepelin and Bleuler (Bleuler, 1950; Kraepelin, 1919). Studies repeatedly find that sleep dysfunction – a term used broadly to include all of self-reported low quality sleep, objectively measured sleep difficulties, and diagnosed sleep disorders – to be highly prevalent in those with psychotic experiences (PEs) such as paranoia (Bagrowska, Pionke-Ubych, Majchrowicz, & Gawęda, 2022; Freeman, Pugh, Vorontsova, & Southgate, 2009). Improved sleep has also been reported as a preferred treatment target for many patients experiencing delusions and other PEs (Freeman, Taylor, Molodynski, & Waite, 2019).

Evidence is also increasingly emerging for the role of sleep dysfunction as a contributory causal factor and treatment target in PEs, particularly delusions and hallucinations (Freeman, 2016; Reeve, Sheaves, & Freeman, 2015). For instance, experimental sleep deprivation studies show that restricting the sleep of healthy individuals to, for example, four hours a night for three consecutive nights, significantly increases paranoia, as well as hallucinations, grandiosity, and cognitive disorganisation (Reeve, Emsley, Sheaves, & Freeman, 2017). Moreover, evidence suggests that treating sleep dysfunction improves paranoia. For instance, in a large randomised controlled trial of cognitive behavioural therapy (CBT) for insomnia versus treatment as usual in over 3500 students with insomnia, those who received the intervention showed reduced paranoia post-treatment, mediated by improved sleep (Freeman et al., 2017).

Overall, there is considerable evidence for the importance of sleep in PEs such as paranoia. Unsurprisingly therefore, there are some existing reviews and meta-analyses assessing the role of some aspect of sleep in psychosis (Chan, Chung, Yung, & Yeung, 2017; Chouinard, Poulin, Stip, & Godbout, 2004; Reeve et al., 2015). However, none are from recent years – despite the significant growth in this literature area – and no

* Corresponding author.
E-mail address: Poppy.brown@hmc.ox.ac.uk (P. Brown).

https://doi.org/10.1016/j.cpr.2024.102503
Received 29 April 2024; Received in revised form 22 July 2024; Accepted 13 September 2024
Available online 18 September 2024

review or meta-analysis has focussed solely on paranoia. Yet the importance of investigating individual PEs one at a time rather than 'psychosis' or 'positive symptoms of psychosis' as a whole has become increasingly recognised. There is significant empirical evidence showing that individual PEs load onto independent factors (Havers, von Stumm, Cardno, Freeman, & Ronald, 2023; Kessler & Wang, 2008; Ronald et al., 2014; Wigman et al., 2009) and have differing levels of environmental and genetic risk (Zavos et al., 2014), e.g., heritability is estimated to be higher for paranoia ($h^2 = 0.52$) than for hallucinations ($h^2 = 0.15$). As a result, there are separate cognitive models for individual PEs such as delusions and hallucinations, and individualised treatments targeting each experience.

The clinical picture, role, or mechanisms of sleep dysfunction in the occurrence of delusions versus hallucinations, for example, may therefore differ, making it important to review the role of sleep for each PE individually. This review and metanalysis focusses on paranoia, given sleep dysfunction is a clear part of cognitive theorising in paranoia (Freeman, 2016) and there is no existing review in this area. Given paranoia lies on a spectrum of severity in the general population ranging from mild suspiciousness and social-evaluative concerns at one end, to persecutory delusions at the other (Bebbington et al., 2013; Freeman et al., 2011; Wong, Freeman, & Hughes, 2014) with a similar factor structure across the spectrum (Shevlin, McElroy, Bentall, Reininghaus, & Murphy, 2017), both clinical and non-clinical studies will be included.

The present study reports both a systematic review and meta-analysis. The primary question addressed by the meta-analysis is: how strong is the relationship between sleep dysfunction and paranoia? The systematic review also qualitatively addresses this question, as well as looking at the extent to which sleep dysfunction has been found to be a causal mechanism in the occurrence of paranoia by assessing whether sleep dysfunction predicts the onset and persistence of paranoia, and whether treating sleep dysfunction helps reduce paranoia. The systematic review also explores what variables have been shown to be mediating and moderating the relationship between sleep and paranoia, given cognitive models hypothesise a number of routes through which sleep dysfunction may impact paranoia, including negative affect, anomalous perceptions, and fatigue (Freeman, 2016).

2. Method

2.1. Systematic review

2.1.1. Search strategy and information sources

The project was conducted with reference to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Page et al., 2021). The protocol was registered on the international prospective register of systematic reviews (CRD42022381709). A systematic search of the literature was conducted, searching Pubmed, Medline, PsychINFO and Embase for English Language papers using the following search terms: (Sleep OR insomnia OR nightmare* OR dream) AND (paranoi* OR delus* OR persec* OR psychotic OR psychosis OR "ideas of reference") appearing in the title. No date restriction was applied.

2.1.2. Inclusion criteria for systematic review

Papers were required to meet all of the following criteria:

- English language papers
- Measure of paranoia
- Measure of sleep
- Analysis assessing the relationship between the measures of paranoia and sleep

2.1.3. Exclusion criteria for systematic review

Papers meeting any of the below criteria were excluded:

- Qualitative studies
- Single case studies
- Studies relating primarily to
  - o Neurological conditions such as dementia
  - o Bipolar or other affective psychoses including post-partum psychosis

2.2. Selection, data collection, and double rating

This search found 858 papers (July 2024). Titles and abstracts were screened then full texts as necessary. Reference lists of included studies and previous systematic reviews on sleep and psychosis were scanned to identify any missed papers. Mendeley and Covidence were used for managing references. Fig. 1 presents a PRISMA diagram summary of the search process. The study selection process was completed by two authors (PB and NS), with the second author reviewing and rating 20 % of title and abstracts (achieving a kappa of 0.83 – near perfect agreement) and 25 % of full texts (achieving a kappa of 1.00 – perfect agreement). Data extraction of included papers was completed by the lead author, with 50 % double rated by NS. The following data were extracted: citation, design, sample size and characteristics, measures of sleep and paranoia used, and a summary of the study findings regarding the relationship between sleep and paranoia.

2.3. Quality appraisal

The quality of included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). This measure is useful for assessing quality across a range of methodological designs unlike many other tools that are specific, for instance, to RCTs. The MMAT's latest version (2018) includes two screening questions and 25 criteria, appraising five categories of study designs. Two categories are for qualitative designs, so only three categories were used for the present review: RCT, quantitative nonrandomised (e.g. non-randomised experiments, cohort studies, experience sampling methodology studies) and quantitative descriptive studies (e.g. cross-sectional studies and case series). The appropriate category was chosen for each study. If the screening criteria were met, then the study was assessed on the five items in its category, leading to a score of between 0/5 and 5/5. Fifty percent of studies were double rated (PB, NS) with a Cohen's kappa was 0.93 – near perfect agreement. Disagreements were discussed and resolved to arrive at a final decision.

2.4. Meta-analysis

A meta-analysis was conducted to synthesise the extent of the relationship between paranoia and sleep disturbance. The primary meta-analysis included studies where a cross-sectional measure of correlation between self-reported sleep disturbance and paranoia was reported, or access to data where such a correlation could be calculated. Any measure of sleep and paranoia was permitted in the initial analysis, so long as the measures of paranoia and sleep contained a minimum of five items. Measures of 0–4 items were considered very brief and less likely to form a coherent continuous factor, whereas a minimum of five items was considered sufficient to be combined as a measure. Following this, a subgroup analysis was conducted where studies were separated according to a stricter set of criteria applied to the measures that were included. A list of all measures used in initial meta-analysis was compiled and from these it was decided a priori which measures would be considered the most robust, homogenous, and well-validated dimensional measures. For sleep there were four measures of insomnia fitting these more specific criteria: The Insomnia Severity Index (ISI) (Bastien, Vallières, & Morin, 2001), Sleep Condition Indicator (SCI) (Espie et al., 2014), Sleep-50 questionnaire (Spoormaker, Verbeek, van den Bout, & Klip, 2005), and PROMIS Sleep Disturbance Scale (Buysse et al., 2010). Measures such as the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1998), or studies reporting

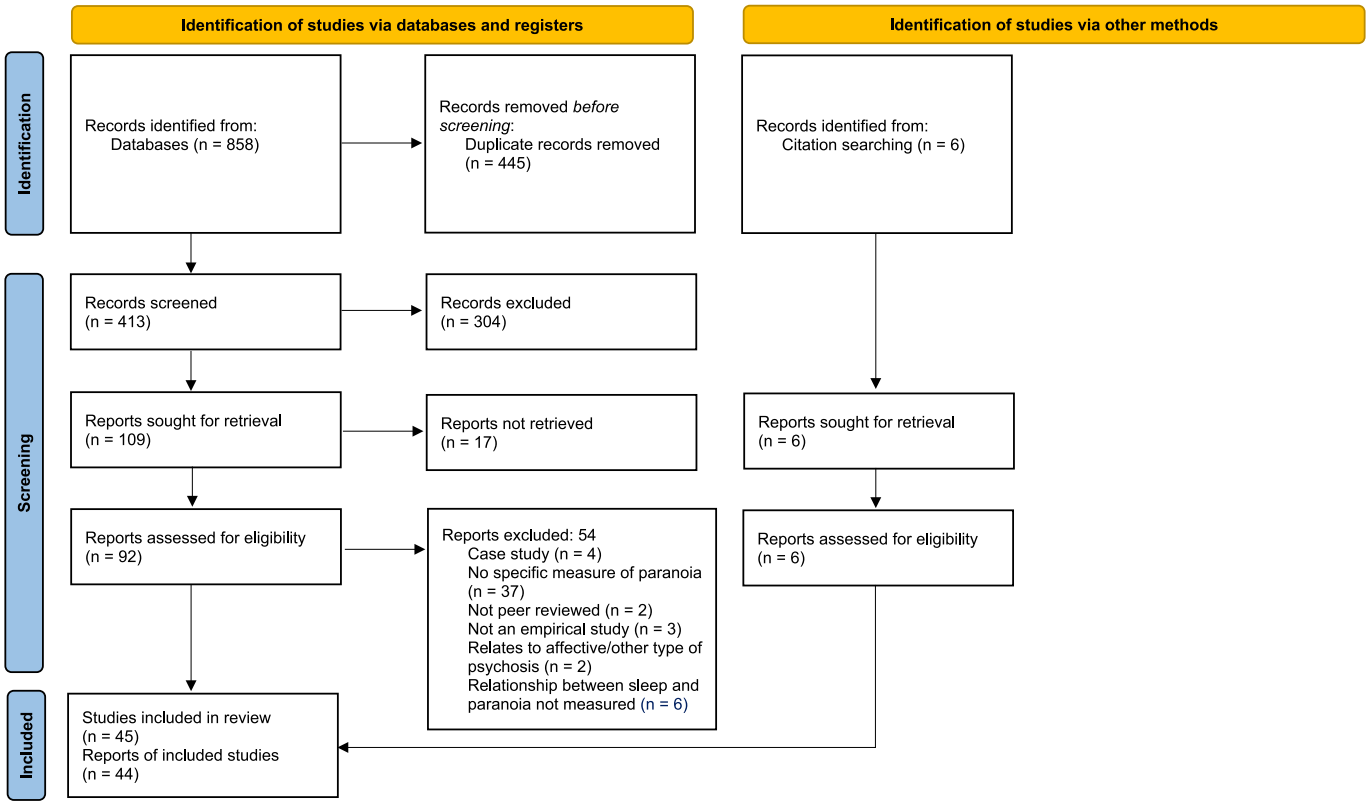

Fig. 1. PRISMA diagram of the search process.
From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: https://doi.org/10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

on sleep quality and duration, were excluded due to their low specificity as clinical measures. Applying similar criteria to the paranoia measures, studies were retained that used the Green et al., Paranoid Thoughts Scale (GPTS) (Green et al., 2008), the Revised Green et al., Paranoid Thoughts Scale (R-GPTS) (Freeman et al., 2019), Paranoia Checklist (Freeman et al., 2005) or the paranoia subscale of the Specific Psychotic Experiences Questionnaire (SPEQ) (Ronald et al., 2014). Again, these are dimensional and well-validated measures specific to paranoia, rather than, for example, the Comprehensive Assessment of At-risk Mental States (CAARMS) (Yung et al., 2005) or Positive and Negative Syndrome Scale (PANSS) (Kay, 1991) which do not provided specific paranoia assessment. The subgroup analysis therefore separated out studies that used one measure from both of these lists versus those that had neither or just one measure from each list.

2.5. Statistical analysis

Statistical analysis was performed using jamovi version 2.0 to comprehensively synthesise the extent of the relationship between paranoia and sleep disturbance. Pearson's r correlation coefficient was used as the primary metric. Where studies reported a different effect size, e.g. an odds ratio, this was converted using recommended computational methods (Cohen, 2013). Where multiple effect sizes were reported, effect sizes unadjusted for mediators were chosen over adjusted, and where multiple robust measures were reported on, the one reported on first (i.e. primary outcomes) was chosen. The analysis was carried out using the Fisher r-to-z transformed correlation coefficient as the outcome measure. A random-effects model was fitted to the data. Heterogeneity of studies was assessed using the *Q*-test and I^2 statistic. As suggested by Higgins, Thompson, Deeks, and Altman (2003), I^2 values of 0 %, 25 %, 50 %, and 75 % indicate no, low, moderate, and high heterogeneity (Higgins et al., 2003). If substantial unaccounted heterogeneity was found in the outcome of interest across studies, it was planned to complete a meta-regression in order to try and explain the variance. Publication bias was assessed via funnel plot inspection, Egger (Egger, Smith, Schneider, & Minder, 1997) and Begg (Begg, 1994) tests, and calculation of Orwin's fail-safe index (Orwin, 1983). A low fail-safe index or an asymmetrical funnel plot can be suggestive of publication bias. The analysis was first completed for all studies included in the meta-analysis, then repeated for the subgroup analysis where studies were separated based on the measures used.

3. Results

3.1. Systematic review

3.1.1. Search results

A total of 45 studies (44 manuscripts, with one study reporting on two separate studies (Rehman, Gumley, & Biello, 2018)) meeting the inclusion criteria for the systematic review were found. This totalled 292,375 participants (range 6–262,382, and total 30,828 when removing one particularly large study). Over a third of studies were based in the UK, with a number of other studies run in Germany, Poland, America, and one study recruiting samples from over 70 different countries. 14 studies recruited clinical participants from clinical mental health services, 25 studies recruited non-clinical samples, and 5 recruited both, leading to a total of 1675 clinical participants and 290,800 non-clinical participants. There were 20 cross-sectional studies, two cohort studies, two longitudinal studies, four case series, five experimental studies, seven experience sampling methodology (ESM) studies, and five randomised controlled trials (RCTs). Summaries of the studies organised by design can be viewed in Tables 1–3, including their score on quality appraisal.

Table 1
Cross-sectional studies.

Citation	N	Participant characteristics	Paranoia Measure	Sleep measure	Comment on findings	Included in Meta-analysis?	Quality Appraisal (out of 5)
Goines 2019	1020	740 individuals ages 12–30 at clinical high risk for psychosis and 280 healthy controls.	Items from the SOPS	Items from the SOPS	The patient group reported significantly more sleep dysfunction than control group. Within the patient group, sleep dysfunction was significantly positively correlated with paranoia, which was partially explained by depression.	N	4
Freeman 2009	330	300 individuals from the general population and 30 individuals with persecutory delusions	GPTS-B	ISI, Sleep-50 Questionnaire	Among the non-clinical sample, symptoms of insomnia were significant positively correlated with paranoia, a relationship that was partially explained by the presence of anxiety and depression. Moderate or severe insomnia was present in over half of those participants with persecutory delusions.	Y	3
Grezellschak 2017	336	46 patients with psychosis, 23 relatives of patients with psychosis, 267 healthy controls	Paranoia Checklist (German version)	ISI (German version)	Paranoia and insomnia were significantly positively correlated in the total sample. The relationship was partially explained by the use of emotional suppression and lack of reappraisal in both the total sample and patient only sample.	Y	3
Reeve 2019	60	Patients with psychosis	SPEQ	Sleep-50 and Consensus sleep diary (subjective), Actigraphy (objective)	80 % of patients received a positive screen or diagnosis of at least one sleep disorder, though fewer than one-third reported having received any treatment Having at least one sleep disorder was significantly associated with more severe paranoia	N	4
Blanchard 2021	90	Patients with psychosis	GPTS	PROMIS Sleep Disturbance and Sleep-Related Impairment short form scales	Sleep dysfunction was significantly positively correlated with paranoia.	Y	3
Levin 2002	116	Students	Items from the Symptom Checklist-90-Revised	21-day dream log	Nightmare frequency and distress was significant positively correlated with paranoia.	N	1
Sheaves 2016	1403	Students	SPEQ paranoia subscale.	SCI-8, dream log, MCTQ	Paranoia was significantly positively correlated with sleep dysfunction, nightmare frequency, and nightmare distress.	N	2
Freeman 2010	8580	Healthy adults	Items from the PSQ	Items from the CIS-R and SCID-II	Insomnia was associated with a two to threefold increase in paranoia. Path analysis showed the association between insomnia and paranoia was partially explained by negative affect, and to a smaller degree, cannabis use.	N	4
Koyanagi 2015	261,547	Adults from the general population from 56 countries. Sample size within countries ranged from 700 to 38,746.	Single item question assessing paranoid feelings	Single item question assessing subjective sleep problems	Self-reporting sleep problems was associated with a significantly high odds of reporting paranoia, which remained significant after controlling for anxiety and depression.	Y	4
Taylor 2015	5000	16-year old twin pairs	SPEQ paranoia subscale	PSQI, ISI	Paranoia was significantly correlated with insomnia and sleep quality. Paranoia and sleep dysfunction shared similar genetic and environmental influences. Negative affect partially mediated the relationship between paranoia and sleep dysfunction, also playing a role in both genetic and environmental influences.	Y	5
Scott 2017	348	Healthy adults	GPTS-B	Sleep-50 insomnia subscale (subjective), Zeo Sleep	No direct association between objectively measured delayed	Y	3

(*continued on next page*)

Table 1 (*continued*)

Citation	N	Participant characteristics	Paranoia Measure	Sleep measure	Comment on findings	Included in Meta-analysis?	Quality Appraisal (out of 5)
				Manager (objective, subset of 91 participants)	sleep onset or sleep maintenance problems and paranoia was seen in the subset of 91 participants wearing the Zeo Sleep manager. Self-reported sleep problems were however significantly associated with increased paranoia. This relationship was fully mediated by increased negative affect.		
Rehman 2018a	401	Healthy adults	GPTS-B	PSQI	Paranoia was significantly positively correlated with sleep dysfunction. The relationship was partially mediated by alexithymia, perceptual anomalies, and negative affect.	Y	2
Rehman 2018b	402	Healthy adults	GPTS-B	PSQI	Paranoia was significantly positively correlated with sleep dysfunction. The relationship fully mediated by alexithymia, perceptual anomalies, and negative affect.	Y	2
Kammerer 2021	486	Young adults (aged 18–27)	Paranoia Checklist (German version)	PSQI, bespoke measures of nightmare frequency and contents, NDQ	Nightmare frequency and distress were significantly associated with paranoia, even after controlling for sleep quality. This relationship was partially mediated by stress. The specific content of nightmares were related to the frequency of paranoia e.g. nightmares about workspace bullying predicted more frequent paranoia.	Y	2
Bagrowska 2022	604	Healthy adults	R-GPTS	PSQI	Self-report questionnaire data showed that sleep quality was significant negatively associated with paranoia, mediated by negative affect.	Y	3
Rek 2017	846	Healthy adults	SPEQ	Nightmare Severity Scale	After controlling for negative affect, both nightmare occurrence and severity were significantly associated with higher paranoia. The association between nightmare and occurrence was no longer significant after controlling for PTSD symptoms and stressful life events, but remained significant for nightmare severity.	N	3
Cosgrave 2021	1789	Healthy adults	Paranoia subscale of Prodromal Questionnaire (16 item version)	PSQI and SCI	Presence of insomnia did not significantly predict the presence of persecutory ideation.	Y	3
Fekih-Romdhane 2023	851	Students	Paranoia subscale of the BSI	Arabic version of the ISI	Paranoia and insomnia were significantly positively correlated.	Y	2
Bird 2019	801	Adolescents (aged 11–15)	B-CAP	ISI	Young people experiencing insomnia had significantly higher paranoia than those without insomnia. However, the relationship was conditionally independent in a direct acyclic graph, meaning the association was sufficiently explained by other variables, most notably negative affect.	N	3
Kammerer 2024	70	Young adults (18–39 years)	Paranoia Checklist	Polysomnography, sleep spindle analysis from NREM sleep	Paranoid thoughts were associated with reduced right central spindle amplitude during a 90-min day-time nap.	N	2

Key: SOPS = Scale of Prodromal Symptoms, GPTS = Green Paranoid Thoughts Scale, ISI = Insomnia Severity Index, SPEQ = Specific Psychotic Experiences Questionnaire, SCI = Sleep Condition Indicator, PSQ = Psychosis Screening Questionnaire, CIS-R = Clinical Interview Scale Revised, SCID = Structured Clinical Interview for DSM-IV, PSQI = Pittsburgh Sleep Quality Index, NDQ = Nightmare Distress Questionnaire, BSI = Brief Symptom Inventory, B-CAP = Bird Checklist of Adolescent Paranoia.

Table 2
Case series, cohort, longitudinal, and ESM studies.

Citation	Design	N	Participant characteristics	Paranoia Measure	Sleep measure	Comment on findings	Included in Meta-analysis?	Quality Appraisal (out of 5)
Myers 2011	Case series	15	Patients with persistent persecutory delusions and insomnia	GPTS, PSYRATS delusions subscale	ISI, PSQI	4 sessions of CBT for insomnia led to significant reductions in insomnia, paranoid thoughts, and persecutory delusions with large effect sizes. Changes were maintained at a one-month follow-up.	N	4
Sheaves 2015	Case series	6	Patients with psychosis and frequent distressing nightmares	PSYRATS delusions subscale	PSQI, dream log	Following imagery rehearsal therapy for nightmares, sleep quality improved and delusions scores decreased for four out of five patients who received treatment. Two of these participants' changes in delusion severity were indicative of a statistically reliable change.	N	5
Bradley 2018	Case series	12	Young people at ultra-high risk of psychosis with sleep problems	GPTS	ISI, PSQI, actigraphy, sleep diaries	Patients were offered 8 sessions of CBT for sleep problems. Treatment was acceptable and feasible, and led to large effect size improvements in sleep, negative affect, and paranoia, though the case series was not powered to assess significance of changes.	N	5
Taylor 2022	Case Series	14	Patients with psychosis experiencing current sleep difficulties	RGPTS	ISI, PSQI	A smartphone-based CBT intervention targeting sleep problems was feasible and acceptable. Across the 11 patients included in analysis, there were improvements in insomnia and sleep quality with large effect sizes, and improvements in paranoia with small (ideas of persecution) to moderate (ideas of reference) effect sizes. Confidence intervals for ideas of persecution crossed zero.	N	4
Reeve 2019	Cohort	160	Young people (aged 14–35) with at risk mental state for psychosis.	CAARMS Unusual Thought Content subscale	Sleep items within EPQ interview	Sleep duration was not significantly associated with unusual thought content (ideas of reference, thought insertion, and delusional mood). Shorter sleep duration was associated with more severe delusional ideas cross-sectionally and longitudinally, however the measure of delusions combined both persecutory and grandiose ideas.	N	2
Freeman 2012	Cohort	2382	Adults from the 2000 British National Psychiatric Morbidity Survey	Items from PSQ and SCID-II	Items from the CIS-R	Insomnia predicted both the persistence of existing paranoid thinking over time and the onset of new paranoid thinking. Insomnia was a stronger predictor of paranoia than both anxiety and depression.	N	5
Reeve 2018	Longitudinal	29	Patients with psychosis	SPEQ paranoia subscale	Sleep-50	Current insomnia was significantly positively associated with current paranoia. Insomnia and paranoia also significantly predicted each other over time in a bi-directional relationship mediated by negative affect (anxiety and depression).	Y	4
Bird 2017	Longitudinal	34	Adolescents (aged 11–16) from clinical services	GPTS	ISI	Insomnia was significantly correlated with paranoia at baseline, and significantly predicted paranoia at three months follow up.	Y	5
Hennig 2020		82	Young adults (ages 18–24), 41 with elevated psychosis proneness	State adapted Paranoia Checklist	Items from the German Sleep Society Diary, Actigraphy	Shorter sleep time and negative dream valence predicted paranoia. The relationship between poor sleep and paranoia was bidirectional.	N	3

(*continued on next page*)

Table 2 (*continued*)

Citation	Design	N	Participant characteristics	Paranoia Measure	Sleep measure	Comment on findings	Included in Meta-analysis?	Quality Appraisal (out of 5)
Mulligan 2016		22	Patients with psychosis and insomnia	PSYRATS delusions subscale (baseline), single item assessing persecutory thinking (ESM)	ISI (baseline), actigraphy and CSD (ESM)	Objectively measured sleep fragmentation and reduced subjective sleep quality predicted great paranoia, which was partially mediated by negative affect on awakening.	N	5
Hennig 2018		61	Adolescents aged 14–17	Items from the SPEQ	Items from the German Sleep Society sleep diary, Actigraphy	Shorter sleep time and more dreaming predicted greater paranoia over time. The former relationship was partially mediated by negative affect. Paranoia did not significantly predict any sleep parameters.	N	3
Meyer 2022		36	Patients with psychosis	Mean of 'suspicious' and 'others dislike me' items of PANSS	PSQI, ISI	Sleep quality was significantly negatively correlated with paranoia, over a time lag of 1–5 days. Paranoia also predicted sleep quality. No relationship with sleep duration and paranoia was found. While negative affect and cognitive symptoms mediated the relationship between sleep and total psychosis symptoms, mediation was not assessed with paranoia only.	N	2
Kammerer 2021		106	67 patients with persecutory delusions and 39 healthy controls	PDI (german version)	ISI, Actigraphy	The patient group reported significantly lower sleep quality but significantly high actigraphic-measured sleep duration and efficiency than controls. Circadian disruption was associated with more severe paranoia.	N	3
Kasanova 2020		82	Young adults (ages 18–24), 41 with elevated psychosis proneness	4 bespoke Likert scales measuring state paranoia	Bespoke Likert scale measuring subjective sleep quality	Across the whole sample, poor sleep quality predicted higher paranoia the following morning. This relationship was fully mediated by negative affect. Paranoia in the evening did not predict sleep quality that night.	N	3
Formica 2024		76	Young people at clinical high risk for psychosis	Single likert scale 'I feel paranoid'	4 bespoke items assessing sleep	Each unit increase in self-reported nightly awakenings predicted a 0.28 increase in feeling paranoid the next day	N	2

Key: GPTS = Green Paranoid Thoughts Scale, PSYRATS = Psychotic Symptoms Rating Scale, ISI = Insomnia Severity Index, PSQI = Pittsburgh Sleep Quality Index, RGPTS = Revised Green Paranoid Thoughts Scale, CAARMS = Clinical Assessment of At Risk Mental State, EPQ = Economic Patient Questionnaire, PSQ = Psychosis Screening Questionnaire, SCID = Structured Clinical Interview for DSM-IV, CIS = Clinical Interview Scale, SPEQ = Specific Psychotic Experiences Questionnaire, CSD = Consensus Sleep Diary, PANSS = Positive and Negative Syndrome Scale, PDI = Peters Delusions Inventory.

3.1.2. *Quality appraisal*

All studies scored at least 1 out of 5 on quality appraisal, with only eight scoring a full 5/5. RCTs typically scored the highest, though some had incomplete outcome data and lower adherence to the intervention. Where experimental studies scored low this was typically due to not controlling for potential confounders and not recruiting a representative sample, the latter of which was also a limitation of most cross-sectional studies. The cross-sectional studies also rarely assessed for nonresponse bias, which was also a limitation of two of the four case series.

3.1.3. *Cross-sectional studies*

All but one of the 20 cross-sectional studies found a positive association between sleep problems and paranoia. Quality ratings varied, with studies of this design generally scoring lower on sample representativeness and lack of information on potential non-response bias.

The largest study analysed data from 261,547 members of the general population from across 56 different countries (Koyanagi & Stickley, 2015). Although the measure of paranoia was only two items (one measuring ideas of persecution and one measuring ideas of control by others), the presence of sleep problems was associated with a significantly higher odds (2.38, CI: 2.31–2.96) of reporting paranoia, which remained significant after controlling for anxiety and depression.

Similar findings were reported in other large studies of both adult and adolescent populations. For example, in a study of 8580 adults, insomnia was associated with a two to threefold increase in paranoia, partially mediated by negative affect, and to a smaller degree, cannabis use (Freeman et al., 2010; Freeman, Pugh, Vorontsova, Antley, & Slater, 2010). Similarly, in a study of 5000 16-year old twin pairs, paranoia was significantly correlated with insomnia and sleep quality, and also partially mediated by negative affect, with both paranoia and sleep dysfunction sharing similar genetic and environmental influences (Taylor, Gregory, Freeman, & Ronald, 2015). This study received the only 5/5 quality rating within the set of cross-sectional studies. A smaller study run in Tunisia, although primarily assessing the relationship between internet gaming disorder and psychotic experiences, also found a significant positive relationship between insomnia and paranoia (Fekih-Romdhane et al., 2023) though this study scored only two out of five on quality appraisal due to the student sampling and lack of reporting on non-response bias.

Where some aspect of negative affect was measured (typically anxiety and depression), it was generally found to be a mediator of the relationship. Most studies found only partial mediation, although some

Table 3
Experimental studies and RCTs.

Citation	Design	N	Participant characteristics	Paranoia Measure	Sleep measure	Comment on findings	Included in Meta-analysis?	Quality Appraisal (out of 5)
Petrovsky 2014	Experiment (1 night of sleep deprivation vs usual sleep)	24	Healthy adults	PSI paranoia and delusions subscales	SSS, one night total sleep deprivation	Baseline levels of paranoia and delusional thinking were low, and did not significantly change following sleep deprivation.	N	3
Kahn-Greene 2007	Experiment (pre vs post 56 h of wakefulness)	25	Healthy adults from the military	Items from the PAI	Adherence to sleep deprivation/ wakefulness	Sleep deprivation (56 h of wakefulness) led to an increase in paranoia compared to baseline.	N	2
Meyhofer, Steffens, 2017	Experiment (24 h of wakefulness vs usual sleep)	36	17 adults reporting unusual experiences and 19 controls reporting low levels of unusual experience	PSI	Adherence to sleep deprivation/ wakefulness	Sleep deprivation led to increased paranoia compared to baseline.	N	2
Reeve 2017	Experiment (sleep reduced to 4 h a night for three nights vs usual sleep)	68	Healthy adults	SPEQ	Adherence to sleep restriction, Actigraphy (objective)	Sleep deprivation to four hours sleep for three consecutive nights led to significant increases in paranoia, 90 % of which was mediated by changes in negative affect (depression, anxiety, and stress).	N	4
Meyhofer, Kumari, 2017	Experiment (1 night of sleep deprivation vs usual sleep)	32	Healthy adults	PSI paranoia subscale	SSS (subjective), SPEM (objective)	Paranoia decreased from evening to morning after one night of total sleep deprivation only when sleep deprivation was the first night, and not when the normal sleep control condition was first.	N	3
Sheaves 2019	RCT (4 weeks of CBT for nightmares vs usual care)	24	Patients with persecutory delusions and nightmares	GPTS	DDNSI, SCI, PSQI	A CBT intervention for nightmares led to improvements in nightmares and insomnia and reductions in paranoia, all with large effect sizes.	N	5
Freeman 2017	RCT (10 weeks of digital CBT for insomnia vs usual care)	3755	Students with insomnia	GPTS-B	SCI-8 (primary), ISI, DDNSI (secondary)	Digital CBT for insomnia significantly reduced insomnia with a large effect size, and significantly reduced paranoia with a small effect size, compared to controls. Changes in insomnia partially mediated changes in paranoia over time. Mediation in the reverse direction was very small.	N	3
Freeman 2015	RCT (8 sessions of CBT for insomnia vs usual care)	50	Patients with persistent distressing delusions or hallucinations and insomnia	GPTS and PSYRATS delusions subscale	ISI	CBT for insomnia led to reductions in self-reported insomnia severity with large effect sizes by the end of treatment. Benefits were maintained at a 12 week follow up. Effect sizes for improvements in actigraphy data were moderate. Confidence intervals for the effects of treatment on delusions were wide suggesting some patients experience more severe paranoia and others less severe.	N	5
Ludtke 2021	RCT (8 week EviBaS intervention vs usual care)	124	Patients with psychosis	PANSS (baseline), Single item assessment of state paranoia (ESM)	Single item assessment of sleep quality	Intervention on psychotic experience did not lead to changes in sleep quality. Sleep quality predicted subsequent paranoia	N	3
Waite 2023	RCT (12 weeks of SleepWell intervention vs usual care)	40	Young people (14–25 years) at ultra-high risk of psychosis	R-GPTS	ISI	12 weeks of a targeted psychological sleep intervention led to reductions in insomnia and paranoia. The reduction in paranoia had confidence intervals crossing zero at 3 months, but not at 9 months.	N	5

Key: PSI = Psychotomimetic States Inventory, SSS = Stanford Sleepiness Scale, PAI = Personality Assessment Inventory, SPEQ = Specific Psychotic Experiences, SPEM = Smooth Pursuit Eye Movements, GPTS = Green Paranoid Thoughts Scale, DDNSI = Disturbing Dream and Nightmare Severity Index, SCI = Sleep Condition Indicator, PSQI = Pittsburgh Sleep Quality Index, PSYRATS = Psychotic Symptoms Rating Scale, ISI = Insomnia Severity Index, PANSS = Positive and Negative Syndrome Scale.

studies found that after controlling for depression and anxiety, the association between paranoia and sleep was no longer significant (Bird, Evans, Waite, Loe, & Freeman, 2019; Blanchard, Andrea, Orth, Savage, & Bennett, 2021; Scott, Rowse, & Webb, 2017). For example, in a study using network analysis on data from 801 adolescents, the significant correlation between insomnia and paranoia was found to be conditionally independent in a directed acyclic graph, suggesting the association was entirely explained by other variables, predominantly negative affect (Bird et al., 2019). A few studies identified other specific mediators of the relationship between sleep and paranoia beyond anxiety and depression. For instance emotional suppression and lack of reappraisal (Grezellschak, Jansen, & Westermann, 2017), and alexithymia and perceptual anomalies (Rehman et al., 2018).

Five studies recruited patients with psychosis with two of these specifically also exploring the prevalence of sleep dysfunction or disorder. Freeman et al. (2009) found moderate or severe insomnia was present in over half of those participants with persecutory delusions, and Reeve, Sheaves, and Freeman (2019) found that 80 % of the patient sample received a positive screen or diagnosis of at least one sleep disorder, with fewer than one-third reporting having received any treatment for sleep problems. Two of the clinical studies also compared sleep dysfunction in clinical versus non-clinical samples, with Goines et al. (2019) finding that their patient sample reported significantly more sleep dysfunction than their control group, and Grezellschak et al. (2017) finding that the correlation between sleep dysfunction and paranoia, although both significant, was higher for their patient sample ($r = 0.47$) than their control sample ($r = 0.38$). These studies scored slightly higher on quality appraisal due to more representative sampling of their target population (i.e. clinical groups).

Four studies focussed more specifically on nightmares in non-clinical populations with sample sizes ranging from 116 to 1403, predominantly recruiting students or young adults. All four studies found significant correlations, between paranoia and nightmare occurrence and severity (Rek, Sheaves, & Freeman, 2017) and nightmare frequency and distress (Kammerer, Bub, & Lincoln, 2021; Levin & Fireman, 2002; Sheaves et al., 2016), even after controlling for sleep quality (Kammerer, Bub, & Lincoln, 2021). Rek et al. (2017) analysed several mediators, and found the relationship remained significant after controlling for negative affect but was no longer significant after controlling for PTSD symptoms and stressful life events. Similarly, Kammerer, Bub, and Lincoln (2021) found the relationship was partially mediated by stress and that the specific content of nightmares was related to the frequency of paranoia e.g., nightmares about workspace bullying predicted more frequent paranoia. Quality appraisal scores were somewhat low for these studies due to the potential lack of representation in the sampling.

Three studies used objective measures of sleep (Kammerer, Bott, Strakeljahn, & Lincoln, 2024; Reeve, Sheaves, & Freeman, 2019; Scott et al., 2017), though only two analysed these data's relationship to paranoia. Despite significant positive associations between self-reported sleep problems and increased paranoia (a relationship that analysis suggested was fully mediated by negative affect), Scott et al. (2017) found no direct association between objectively measured delayed sleep onset or sleep maintenance and paranoia. Taking a different approach that used polysomnography and sleep spindle analysis during NREM sleep, Kammerer et al. (2024) found that paranoid thoughts were associated with reduced right central spindle amplitude in a group of 70 young adults during a 90-min day-time nap.

The only study not reporting a significant relationship between sleep and paranoia was Cosgrave et al. (2021). They recruited 1789 adults from the general population and found that the presence of insomnia as measured by the SCI did not significantly predict the presence of persecutory ideation as measured by an item within the Prodromal Questionnaire. The study was limited by use of single-item measure of paranoia, however and received 3/5 on the measure of quality appraisal.

3.1.4. Case-series

Four case series evaluated the impact of sleep interventions on patients with psychosis and sleep difficulties with sample sizes of between six and 15. Three of these case studies (Bradley et al., 2018; Myers, Startup, & Freeman, 2011; Sheaves, Onwumere, Keen, & Kuipers, 2015) preceded RCTs also included in this review (Freeman et al., 2015; Sheaves et al., 2019; Waite et al., 2023).

Eight sessions of CBT for sleep problems showed feasibility, acceptability and large effect size changes in both sleep and paranoia in 12 young people at ultra-high risk of psychosis (Bradley et al., 2018). Similarly, following four sessions of CBT-I with 15 adults, Myers and colleagues found over two-thirds of participants made significant improvements in insomnia and half showed significant reductions in persecutory ideation (Myers et al., 2011). At a group level, reductions in insomnia and paranoia were significant and showed large effect sizes.

In a study of a six-week smartphone CBT-I-based intervention, Taylor and colleagues recruited 14 patients, 11 of whom completed the intervention and assessments (Taylor, Bradley, & Cella, 2022). Referral rates and qualitative feedback suggested good acceptability and feasibility, with large effect size improvements in insomnia and sleep quality also seen. Improvements in paranoia showed small (ideas of persecution) to moderate (ideas of reference) effect sizes. Confidence intervals for ideas of persecution crossed zero.

In a case series of 4–6 sessions of Imagery Rehearsal Therapy for nightmares, four out of five patients showed improvements in delusions and sleep quality, though only the changes in delusions were indicative of statistically reliable change (Sheaves et al., 2015).

All four case series scored four or five out of five on quality appraisal, with the only possibilities for concern being risk of non-response bias in Myers et al. (2011) and Taylor et al. (2022) due to possible differences between participants who were contactable and consented to taking part versus those who were not or did not.

3.1.5. Cohort and longitudinal studies

Four studies looked at the relationship between sleep and paranoia over time. In 2382 adults from the 2000 British National Psychiatric Morbidity Survey Insomnia predicted both the persistence of existing paranoid thinking over time and the onset of new paranoid thinking (Freeman et al., 2012). Insomnia was a stronger predictor of paranoia than both anxiety and depression.

In a much smaller clinical study of 29 patients with psychosis, current insomnia was significantly positively associated with current paranoia, and when measured over the course of three months, insomnia and paranoia also significantly predicted each other over time in a bi-directional relationship partially mediated by negative affect (anxiety and depression) (Reeve, Nickless, Sheaves, & Freeman, 2018). Similarly, in a study of 34 adolescents recruited from clinical services, insomnia was significantly associated with paranoia at baseline and significantly predicted paranoia severity three months later (Bird, Waite, Rowsell, Fergusson, & Freeman, 2017).

Finally, in a clinical study of 160 young people (aged 14–35) with at risk mental state for psychosis, shorter sleep duration was associated with more severe delusional ideas both cross-sectionally and longitudinally (across 12–24 months), however the measure of delusions combined both persecutory and grandiose ideas so there is less specificity regarding paranoia in this study (Reeve et al., 2019).

3.1.6. ESM studies

Seven studies used ESM methodologies. All reported significant associations between some aspect of sleep and paranoia, though there were differences in the exact sleep variable showing a significant relationship and whether the relationship was bi-directional. Where negative affect was measured, it was generally found to be a mediator.

In two studies, one of 82 young adults (aged 18–24) and one of adolescents (aged 14–17) Hennig and colleagues found that shorter sleep time predicted paranoia over 14 days (Hennig, Schlier, & Lincoln, 2020) and 8 days (Hennig & Lincoln, 2018). Interestingly, in the former study the relationship between sleep and paranoia was bi-directional, whereas in the latter, paranoia did not significantly predict any sleep parameters. Dreaming, (specifically negative dream valence in Hennig et al., 2020 and greater dreaming in Hennig & Lincoln, 2018) also predicted the presence of paranoia over time in both studies. Negative affect was not measured in the 2018 study but was a significant mediator in the 2020 study. Mulligan, Haddock, Emsley, Neil, and Kyle (2016) had similar findings, with reduced sleep quality predicting greater paranoia over seven days, partially mediated by negative affect (Mulligan et al., 2016). This study also used actigraphy and found sleep fragmentation also predicted greater paranoia.

Interestingly, a significant negative bi-directional relationship was found between sleep quality and paranoia in Meyer and colleagues (Meyer et al., 2022), but not for sleep duration and paranoia as was seen in the studies by Hennig and colleagues. In another study, poor sleep quality predicted higher paranoia the following morning (mediated by negative affect) but did not find a relationship in the other direction, with evening paranoia not predicting sleep quality that night (Kasanova, Hajdúk, Thewissen, & Myin-Germeys, 2020). In 76 young people at clinical high risk for psychosis, it was found that every unit in self-reported nightly awakenings predicted an 0.28 increase in feeling paranoid the next day, a relationship that was not impacted by previous day negative affect or substance use (Formica et al., 2024). No other measure of sleep (time taken to fall asleep, time awake prior to rising, or sleep quality) significantly predicted paranoia. This study was limited by single item measures and scored only 2/5 on quality appraisal.

In the largest ESM study of 67 patients with persecutory delusions and 39 healthy controls it was found that the patient group reported significantly lower sleep quality, but higher sleep duration and efficiency (objectively measured through actigraphy), than controls, with low actigraphy-derived sleep efficiency across the total sample being associated with more severe next-day paranoia (Kammerer, Mehl, Ludwig, & Lincoln, 2021).

3.2. Experimental sleep deprivation studies

Meyhöfer et al. (2017) recruited 17 individuals reporting unusual experiences and 19 controls reporting no unusual experiences and found that across both groups, 24 h of wakefulness led to increased paranoia as compared to baseline. Similarly, Kahn-Greene, Killgore, Kamimori, Balkin, and Kilgore (2007) found 56 h of wakefulness led to increased paranoia from baseline in 25 adults. Conversely, a study by Petrovsky and colleagues found that one night of total sleep deprivation (equating to a minimum of 12 h for all participants) did not lead to any significant changes in paranoia (Petrovsky et al., 2014). Results were possibly impacted by a floor effect of baseline paranoia and the total sleep deprivation window being shorter and more varied in total time between participants than in other studies. All three of these studies were rated as slightly low in methodological quality (scoring 2 or 3 out of 5) due to their sampling and chosen measures.

Two further sleep deprivation studies used randomised cross-over designs. Reeve et al. (2017) randomised 68 adults to four hours of sleep for three consecutive nights or normal sleep in a cross-over design and found that sleep loss led to significant increases in paranoia, 90 % of which was mediated by changes in negative affect (depression, anxiety, and stress). The second study randomised 32 adults to have one night total sleep deprivation followed by a normal night's sleep, or vice versa (Meyhöfer, Kumari, et al., 2017). Interestingly, paranoia decreased from evening to morning following sleep deprivation, but only in one of the groups (those who underwent sleep deprivation followed by normal sleep condition rather than those following the conditions in reverse). Otherwise, no changes in paranoia were seen. This study scored only 3/5 on quality appraisal due to poorer reporting of sample representativeness and confounders.

3.3. Treatment RCTs

Three of the five RCTs were developed from the case series reported earlier (Bradley et al., 2018; Freeman et al., 2015; Sheaves et al., 2019). In a trial of 24 participants with nightmares and persecutory delusions, Sheaves et al. (2019) found their CBT intervention for nightmares led to improvements in nightmares and insomnia, and reductions in paranoia, all with large effect sizes. In 40 young people at ultra-high risk of psychosis, Waite et al. (2023) found that a 12-week sleep intervention led to improvements in insomnia and also paranoia, the latter of which were significant at follow up (9 months after baseline) but not at 3 months. The same pattern was observed for anxiety and depression, consistent with the potential mediating role of affective symptoms in the relationship between sleep and paranoia. In a trial of 50 patients, Freeman et al. (2015) similarly found large effect size improvements in insomnia following CBT—I, with improvements maintained at a 12-week follow up. However, there were wide confidence for the effects of the treatment on persecutory delusions, with some patients' delusions improving while others experienced a worsening of their delusions. A more highly powered phase three trial would be required to determine the effects on delusions with greater precision. All three studies also were rated as having a low risk of bias, scoring the highest possible score for their category.

Freeman et al. (2017) conducted the largest RCT of 3755 university students with insomnia. The study found that compared to a control group, the digital CBT-I intervention significantly reduced insomnia with a large effect size, and significantly reduced paranoia with a small effect size. Changes in insomnia partially mediated changes in paranoia over time, where-as mediation in the reverse direction was very small. While it scored slightly lower on quality appraisal (3/5) this was due to relatively low treatment uptake (30 % of the intervention group did not access any of the modules) and high dropout rates (50 %), which may be considered unsurprising given the online nature of the study and the student sample, many of whom potentially had a low need for care.

Finally, one study of 124 patients with distressing delusions or hallucinations and insomnia embedded experience sampling assessments into a cross-over trial of an online psychological intervention (Lüdtke et al., 2021). The intervention (EviBaS) targeted psychotic symptoms as well as potential precursors of psychosis using guided self-help modules on topics such as sleep, worry, self-esteem and depression. Results showed that 30 % of participants accessed the sleep module and 30 % accessed the persecutory delusions module. While the intervention did lead to a significant reduction in a composite score of positive psychotic symptoms, it did not lead to significant changes in sleep quality, or paranoia. The ESM data, however, was able to show that across the whole sample, (whether delayed or immediate access to treatment), decreased sleep quality significantly predicted subsequent momentary paranoia during the course of the intervention. As is common in ESM studies, there was lower adherence to measure collection, and as is common in online interventions, there was also somewhat low adherence to treatment. Thus, this study scored slightly lower on quality appraisal (3/5).

3.4. Meta-analysis results

3.4.1. Primary meta-analysis

After excluding five studies for having measures of sleep and or

paranoia that contained fewer than five items (three studies used single items, one used two items, and one three items), 14 studies were included in the primary meta-analysis. Three comprised clinical samples, one comprised both clinical and non-clinical participants, and the remainder comprised non-clinical samples. There was a significant positive association between sleep and paranoia, with a pooled effect size of 0.27 (95 % CI: 0.20 to 0.35, $p < 0.001$, $tau^2 = 0.016$ [SE = 0.01], $I^2 = 96.25$ %, $p < 0.001$). Converted back into Pearon's r this gave a

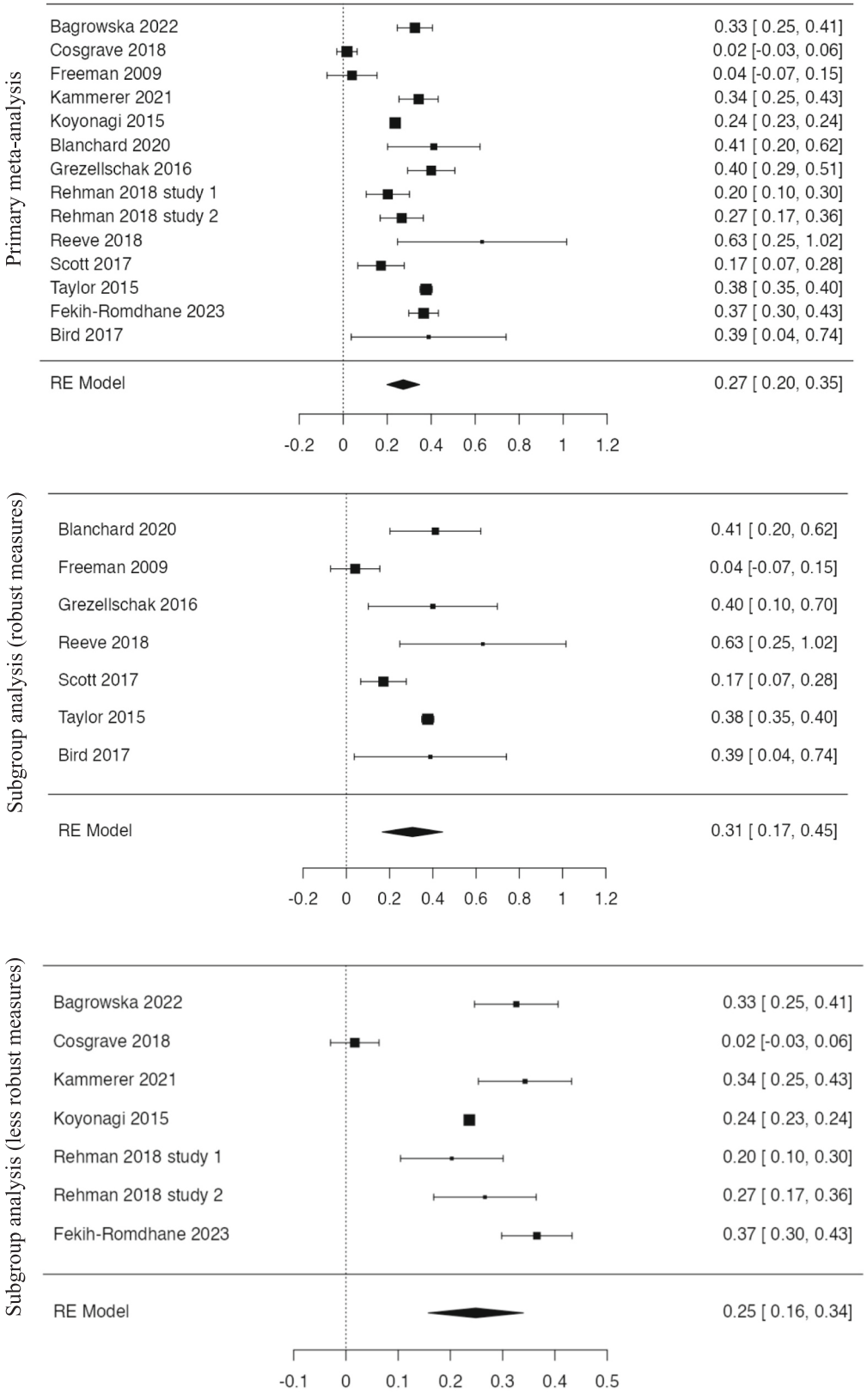

Fig. 2. Fig. 2. Forest Plots.

small effect size of 0.26. Fig. 2 presents a forest plot showing variance between the studies and the overall measure of effect (z scores). There was no indication of publication bias according to funnel plot inspection. Neither Begg's rank correlation nor Egger's regression test indicated asymmetry ($p = 0.83$ and $p = 0.13$, respectively). The fail-safe index was large, at 15,389.

The significant heterogeneity statistics suggest that a large proportion of the variance in effect size was attributable to between-study variance. However, a meta-regression or sensitivity analysis to explore this further was not considered appropriate for two reasons. First, while it is possible that variables such as sample size (which ranged between 26 and over 26,000) and population (clinical, non-clinical, or both) were contributing to the heterogeneity, with only 14 studies included (and only three with clinical samples) there would not be particularly high power to explore potential predictors. Second, given all studies found a positive effect, with only two having confidence intervals crossing zero, further analysis would be unlikely to change the direction of the concluded effect, and only potentially impact the magnitude of the effect by a small amount.

3.5. Subgroup analysis

Seven studies included the specific, continuous, clinically relevant, and therefore more homogonous measures of paranoia and insomnia and six did not. For the set of homogonous measures, the average correlation coefficient showed a significant positive association between insomnia and paranoia, with a pooled effect size of 0.31 (95 % CI: 0.17–0.45, $p < 0.001$, $tau^2 = 0.02$ [SE = 0.02], $I^2 = 86.0$ %, $p < 0.001$). Conversion back into Pearon's r gave a medium effect size of 0.30. Neither the rank correlation nor the regression test indicated any funnel plot asymmetry ($p = 1.00$ and $p = 0.19$ respectively) and the fail-safe index was large, at 657. The variance between the studies and the overall measure of effect can be viewed in Fig. 2.

For the seven studies with less homogonous measures, the average correlation coefficient showed a significant positive association between insomnia and paranoia, with a pooled effect size of 0.25 (95 % CI: 0.16–0.34, $p < 0.001$, $tau^2 = 0.01$ [SE = 0.01], $I^2 = 95.34$ %, $p < 0.001$). Converted back into Pearson's r, the effect size remained at 0.25. Neither the rank correlation nor the regression test indicated any funnel plot asymmetry ($p = 0.38$ and $p = 0.46$, respectively) and the fail-safe index was large, at 9115. The forest plot for this set of studies can also be viewed in Fig. 2.

4. Discussion

This systematic review aimed to comprehensively synthesise the relationship between sleep and paranoia, including assessing the magnitude of its association through a meta-analysis for the first time. Both meta-analyses demonstrated there is a significant moderate association between insomnia and paranoia, and the systematic review showed this association can be reliably discovered through multiple designs and has at least some causal element to it.

While cross-sectional designs were unsurprisingly by far the most commonly used, the longitudinal and cohort studies also found significant positive associations between sleep dysfunction and paranoia, and experimental studies showed that when sleep is manipulated in either direction (i.e. improved or decreased) this has a subsequent effect on paranoia (i.e. decreases or increases). These latter findings of the impact of manipulating sleep offer evidence to suggest that sleep dysfunction could be a contributory causal factor in the development and/or maintenance of paranoia. Further weight is provided to this conclusion by the four clinical treatment RCTs that demonstrated that when cognitive therapy for sleep problems successfully led to improvements in sleep, this had a subsequent impact on reducing paranoia. Given the relative ease of intervening to improve sleep dysfunction and the motivation patients often have to improve sleep (Freeman, Taylor, et al., 2019), providing sleep interventions to those with an at risk mental state for developing psychosis would seem a useful avenue of research to see whether this could be one way of reducing the likelihood of transition to psychosis. The SleepWell case series and pilot RCT (Bradley et al., 2018; Waite et al., 2023) provide initial evidence of this, with a full RCT still needed to assess efficacy.

The studies that used mediation analysis were able to shed further light on the nature of the relationship between sleep and paranoia. In a number of studies it appeared that the relationship from sleep to paranoia was primary (Hennig & Lincoln, 2018; Kasanova et al., 2020) whereas in others there was evidence of a bi-directional relationship (Meyer et al., 2022; Hennig et al., 2020). Typically, it is hypothesised that bidirectional relationships between paranoia and its causal factors become embedded (Freeman, 2016). An interesting avenue of future research would therefore be to assess whether interventions that successfully reduce paranoia also lead to a subsequent improvement in sleep, and if they do not, whether this increases the likelihood of paranoia relapsing.

Aspects of negative affect e.g., anxiety and depression were also frequently assessed as mediators, likely because of their ease of measurement and presence within theoretical models. When measured, negative affect was indeed commonly found to be a meditator. Conceptually this pathway makes a lot of sense: reducing anxiety and improving mood improves paranoia (Freeman, 2016), and improving sleep is a means to achieving this. Sleep disruption also has wider impacts, such as on cognition and memory, yet the pathway with negative affect is typically the strongest (Reeve, Emsley, Sheaves and Freeman, 2017). Nonetheless, investigation of other potential mediating variables is important. Larger longitudinal studies would be useful for robustly measuring and assessing the potential role of a range of cognitive, affective, and behavioural variables in more detail, such as rumination, alexithymia, anomalous experiences, and fatigue. Assessment of sleep dysfunction in those with paranoia could also be broadened to cover a wider range of sleep difficulties, including, for example, parasomnias. There is emerging evidence and a clear theoretical model for the role of nightmares in increasing paranoia (Sheaves et al., 2019), but also the potential of other parasomnias like sleep paralysis and sleep-related hallucinations to play a significant role in causing or maintaining daytime paranoia, that require further investigation.

It is helpful to note that the results of the primary meta-analysis as well as the two sub-group analyses were similar. This suggests that measure quality is unlikely to have a large impact on finding a reliable association between sleep and paranoia. The pooled correlation was highest for the analysis of more specific and clinically-valid measures, however, which implies that those studies using less robust measures may actually be diluting the true effect. We recommend in future that studies aim more consistently to use the most robust and clinically-valid measures of sleep and paranoia, for example the R-GPTS and the ISI. There was at no point any evidence of publication bias, including a very high fail-safe index in the primary meta-analysis, which is also useful for demonstrating the reliability of the relationship and how likely it is to be a true effect even if there were considerable publication bias.

Visual inspection of the forest plots indicates potential moderators that could be examined in more detail. For example, the clinical studies appeared to have slightly larger effects than the non-clinical studies. While both paranoia and sleep difficulties exist on a spectrum of severity across the population, with differences at the clinical end often representing more quantitative than qualitative differences (Elahi, Perez Algorta, Varese, McIntyre, & Bentall, 2017; Freeman, Pugh, et al., 2010), studies recruiting entirely non-clinical samples may sometimes be biased by a floor effect, as was thought to potentially be the case in e.g. Petrovsky et al., (2014), which might make the relationship easier to discover in clinical groups.

Age could also be explored as a moderator in greater detail. While there were no obvious differences in the findings reported by studies with adolescent populations as compared to adults, adolescents are

more suspectable to certain sleep difficulties. For example, they experience both delayed and reduced feelings of needing to sleep at night due to differences in their release of melatonin (Blake, Sheeber, Youssef, Raniti, & Allen, 2017; Feinberg, Higgins, Wong, & Campbell, 2006) yet typically still need to rise early in the morning for school leading to insufficient sleep duration. It is therefore possible that the strength of the relationship between sleep and paranoia and the mechanisms underlying it could be different for adolescents as compared to adults.

There are several limitations of the review and meta-analysis to consider. First, there is no way to guarantee that the search strategy identified every study that would meet inclusion criteria. Methods to reduce this likelihood were employed, such as scanning past reviews and reference lists of included studies, but a number of studies may not have been found. Furthermore, we chose to exclude case studies and unpublished studies, but including these may have provided further insight into some areas of the relationship between sleep and paranoia. Second, the meta-analysis only quantitatively assessed and pooled r correlation coefficients of the association between sleep and paranoia, with no quantitative analysis of e.g. intervention effect sizes or group differences. This was because of the limited number of studies using experimental designs but would be a useful area of future research as the more studies in this area emerge. Similarly, the review only focussed on paranoia because of the importance of considering psychotic experiences individually, but given PEs commonly co-occur, it would also be useful to review and meta-analytically assess and compare the relationship between sleep and other psychotic experiences such as hallucinations and anhedonia. For instance, Reeve et al. (2017) found that although sleep disruption was also significantly associated with hallucinations, negative affect was a much stronger mediator for paranoia than hallucinations. Finally, the narrative review also gave considerably more focus to the findings with regard to subjective measures of sleep than objective ones. With the advent of increasingly easy ways to objectively measure aspects of sleep and many individuals opting to track their sleep using at-home devices, this may be an important area to focus future research.

In conclusion, it has been increasingly recognised in recent years that sleep dysfunction is not only a common occurrence in those with psychosis including paranoia specifically, but that it also plays a contributory causal role in its development and maintenance. This review and analysis provide an up-to-date synthesis of this evidence so far and provides a number of avenues for whether to focus future research. These include investigating sleep difficulties beyond insomnia (e.g., parasomnias), assessing the sleep to paranoia relationship in reverse, (e.g., does successfully reducing paranoia also lead to a subsequent improvement in sleep), and conducting larger longitudinal studies using clinically relevant measures that allow in depth investigation into pathways that may more clearly explain the mechanisms by which sleep and paranoia are causally related.

Funding

The project was completed as part of the doctoral studies of the lead author within her Clinical Psychology Training within Oxford Health NHS Foundation Trust.

Contributors

PB devised the study, ran and completed the initial search, screening, data extraction, and meta-analysis, and drafted the manuscript. NS second rated each stage of the search and extraction. MH provided input on the meta-analysis. CS and SR supervised the project. All authors approved the final version of the manuscript.

Declaration of competing interest

The authors declare no conflicts of interests.

Data availability

Data will be made available on request.

Acknowledgments

None.

References

Bagrowska, P., Pionke-Ubych, R., Majchrowicz, K., & Gawęda, Ł. (2022). The mediating effect of negative emotions on the relationship between subjective sleep quality and paranoia-like thoughts. *Journal of Psychiatric Research, 145*(December 2021), 132–136. https://doi.org/10.1016/j.jpsychires.2021.12.003

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Medicine, 2*(4), 297–307. https://doi.org/10.1016/S1389-9457(00)00065-4

Bebbington, P. E., McBride, O., Steel, C., Kuipers, E., Radovanovič, M., Brugha, T., … Freeman, D. (2013). The structure of paranoia in the general population. *British Journal of Psychiatry, 202*(6), 419–427. https://doi.org/10.1192/bjp.bp.112.119032

Begg, C. B. (1994). Publication bias. In *, 25. The Handbook of Research Synthesis* (pp. 299–409).

Bird, J. C., Evans, R., Waite, F., Loe, B. S., & Freeman, D. (2019). Adolescent paranoia: Prevalence, structure, and causal mechanisms. *Schizophrenia Bulletin, 45*(5), 1134–1142. https://doi.org/10.1093/schbul/sby180

Bird, J. C., Waite, F., Rowsell, E., Fergusson, E. C., & Freeman, D. (2017). Cognitive, affective, and social factors maintaining paranoia in adolescents with mental health problems: A longitudinal study. *Psychiatry Research, 257*(February), 34–39. https://doi.org/10.1016/j.psychres.2017.07.023

Blake, M. J., Sheeber, L. B., Youssef, G. J., Raniti, M. B., & Allen, N. B. (2017). Systematica review and meta-analysis of adolescent cognitive–behavioral sleep interventions. *Clinical Child and Family Psychology Review, 20*(3), 227–249. https://doi.org/10.1007/s10567-017-0234-5

Blanchard, J., Andrea, A., Orth, R., Savage, C., & Bennett, M. (2021). Sleep disturbance and sleep-related impairment in psychotic disorders are related to both positive and negative symptoms. *Psychiatry Research, 14*(11), 1–15. https://doi.org/10.1016/j.psychres.2020.112857.Sleep

Bleuler, E. (1950). In J. Zinkin, & N. Lewis (Eds.), *Dementia praecox or the group of schizophrenias*.

Bradley, J., Freeman, D., Chadwick, E., Harvey, A. G., Mullins, B., Johns, L., … Waite, F. (2018). Treating sleep problems in young people at ultra-high risk of psychosis: A feasibility case series. *Behavioural and Cognitive Psychotherapy, 46*(3 PG-276–291), 276–291. https://doi.org/10.1017/S1352465817000601

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1998). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. In *, Vol. 28. Psychiatry Research* (pp. 193–213).

Buysse, D. J., Yu, L., Moul, D. E., Germain, A., Stover, A., Dodds, N. E., … Pilkonis, P. A. (2010). Development and validation of patient-reported outcome measures for sleep disturbance and sleep-related impairments. *Sleep, 33*(6), 781–792.

Chan, M. S., Chung, K. F., Yung, K. P., & Yeung, W. F. (2017). Sleep in schizophrenia: A systematic review and meta-analysis of polysomnographic findings in case-control studies. *Sleep Medicine Reviews, 32*, 69–84. https://doi.org/10.1016/j.smrv.2016.03.001

Chouinard, S., Poulin, J., Stip, E., & Godbout, R. (2004). Sleep in untreated patients with schizophrenia: A meta-analysis. *Schizophrenia Bulletin, 30*(4), 957–967. https://doi.org/10.1093/oxfordjournals.schbul.a007145

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Cosgrave, J., Purple, R. J., Haines, R., Porcheret, K., van Heugten-van der Kloet, D., Johns, L, … Wulff, K. (2021). Do environmental risk factors for the development of psychosis distribute differently across dimensionally assessed psychotic experiences? *Translational Psychiatry, 11*(1), 226.

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ, 315*(7109), 629–634.

Elahi, A., Perez Algorta, G., Varese, F., McIntyre, J. C., & Bentall, R. P. (2017). Do paranoid delusions exist on a continuum with subclinical paranoia? A multi-method taxometric study. *Schizophrenia Research, 190*, 77–81. https://doi.org/10.1016/j.schres.2017.03.022

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The sleep condition Indicator: A clinical screening tool to evaluate insomnia disorder. *BMJ Open, 4*(3).

Feinberg, I., Higgins, L. M., Wong, Y. K., & Campbell, I. G. (2006). The adolescent decline of NREM delta, an indicator of brain maturation, is linked to age and sex but not to pubertal stage. *American Journal of Physiology - Regulatory Integrative and Comparative Physiology, 291*(6), 1724–1730. https://doi.org/10.1152/ajpregu.00293.2006

Fekih-Romdhane, F., Lamloum, E., Loch, A. A., Cherif, W., Cheour, M., & Hallit, S. (2023). The relationship between internet gaming disorder and psychotic experiences: Cyberbullying and insomnia severity as mediators. *BMC Psychiatry, 23*(1), 1–14. https://doi.org/10.1186/s12888-023-05363-x

Formica, M. J. C., Fuller-Tyszkiewicz, M., Reininghaus, U., Kempton, M., Delespaul, P., De Haan, L., … Hartmann, J. A. (2024). Associations between disturbed sleep and attenuated psychotic experiences in people at clinical high risk for psychosis. *Psychological Medicine*. https://doi.org/10.1017/S0033291724000400

Freeman, D. (2016). Persecutory delusions: A cognitive perspective on understanding and treatment. *The Lancet Psychiatry, 3*(7), 685–692. https://doi.org/10.1016/S2215-0366(16)00066-3

Freeman, D., Brugha, T., Meltzer, H., Jenkins, R., Stahl, D., & Bebbington, P. (2010). Persecutory ideation and insomnia: Findings from the second British National Survey of Psychiatric Morbidity. *Journal of Psychiatric Research, 44*(15), 1021–1026. https://doi.org/10.1016/j.jpsychires.2010.03.018

Freeman, D., Garety, P. A., Bebbington, P. E., Smith, B., Rollinson, R., Fowler, D., & Kuipers, E. (2005). Psychological investigation of the structure of paranoia in a non-clinical population. *British Journal of Psychiatry, 186*, 427–435. https://doi.org/10.1192/bjp.186.5.427

Freeman, D., Loe, B. S., Kingdon, D., Startup, H., Molodynski, A., Rosebrock, L., … Bird, J. C. (2019). The revised Green et al., Paranoid Thoughts Scale (R-GPTS): psychometric properties, severity ranges, and clinical cut-offs. *Psychological Medicine*, 1–10. https://doi.org/10.1017/s0033291719003155

Freeman, D., McManus, S., Brugha, T., Meltzer, H., Jenkins, R., & Bebbington, P. (2011). Concomitants of paranoia in the general population. *Psychological Medicine, 41*(05), 923–936. https://doi.org/10.1017/S0033291710001546

Freeman, D., Pugh, K., Vorontsova, N., Antley, A., & Slater, M. (2010). Testing the continuum of delusional beliefs: An experimental study using virtual reality. *Journal of Abnormal Psychology, 119*(1), 83–92. https://doi.org/10.1037/a0017514

Freeman, D., Pugh, K., Vorontsova, N., & Southgate, L. (2009). Insomnia and paranoia. *Schizophrenia Research, 108*(1–3), 280–284. https://doi.org/10.1016/j.schres.2008.12.001

Freeman, D., Sheaves, B., Goodwin, G. M., Yu, L. M., Nickless, A., Harrison, P. J., … Espie, C. A. (2017). The effects of improving sleep on mental health (OASIS): A randomised controlled trial with mediation analysis. *The Lancet Psychiatry, 4*(10), 749–758. https://doi.org/10.1016/S2215-0366(17)30328-0

Freeman, D., Stahl, D., McManus, S., Meltzer, H., Brugha, T., Wiles, N., & Bebbington, P. (2012). Insomnia, worry, anxiety and depression as predictors of the occurrence and persistence of paranoid thinking. *Social Psychiatry and Psychiatric Epidemiology, 47*(8), 1195–1203. https://doi.org/10.1007/s00127-011-0433-1

Freeman, D., Taylor, K. M., Molodynski, A., & Waite, F. (2019). Treatable clinical intervention targets for patients with schizophrenia. *Schizophrenia Research, 211*, 44–50. https://doi.org/10.1016/j.schres.2019.07.016

Freeman, D., Waite, F., Startup, H., Myers, E., Lister, R., McInerney, J., … Yu, L.-M. M. (2015). Efficacy of cognitive behavioural therapy for sleep improvement in patients with persistent delusions and hallucinations (BEST): A prospective, assessor-blind, randomised controlled pilot trial. *The Lancet Psychiatry, 2*(11), 975–983. https://doi.org/10.1016/S2215-0366(15)00314-4

Goines, K. B., LoPilato, A. M., Bearden, C. E., Cadenhead, K. S., Cannon, T. D., … Walker, E. F. (2019). Sleep problems and attenuated psychotic symptoms in youth at clinical high-risk for psychosis. *Psychiatry Research, 282*, 112492.

Green, C. E. L., Freeman, D., Kuipers, E., Bebbington, P., Fowler, D., Dunn, G., & Garety, P. A. (2008). Measuring ideas of persecution and social reference: The Green et al. Paranoid thought scales (GPTS). *Psychological Medicine, 38*(01), 101–111. https://doi.org/10.1017/S0033291707001638

Grezellschak, S., Jansen, A., & Westermann, S. (2017). Emotion regulation in patients with psychosis: A link between insomnia and paranoid ideation? *Journal of Behavior Therapy and Experimental Psychiatry, 56*, 27–32. https://doi.org/10.1016/j.jbtep.2016.08.001

Havers, L., von Stumm, S., Cardno, A. G., Freeman, D., & Ronald, A. (2023). Psychotic experiences and negative symptoms from adolescence to emerging adulthood: Developmental trajectories and associations with polygenic scores and childhood characteristics. *Psychological Medicine, 53*(12), 5685–5697. https://doi.org/10.1017/S0033291722002914

Hennig, T., & Lincoln, T. M. (2018). Sleeping paranoia away? An actigraphy and experience-sampling study with adolescents. *Child Psychiatry & Human Development, 49*, 63–72.

Hennig, T., Schlier, B., & Lincoln, T. M. (2020). Sleep and psychotic symptoms: An actigraphy and diary study with young adults with low and elevated psychosis proneness. Schizophrenia Research, 221(Adan, A., Almirall, H. (1991)). Horne & Ostberg morningness-eveningness questionnaire: A reduced scale. *Personality and Individual Differences, 12*(3), 241–253. https://doi.org/10.1016/0191-8869(91)90110-W

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327*(7414), 557–560.

Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., … Pluye, P. (2018). The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. *Education for Information, 34*(4), 285–291. https://doi.org/10.3233/EFI-180221

Kahn-Greene, E. T., Killgore, D. B., Kamimori, G. H., Balkin, T. J., & Kilgore, W. D. (2007). The effects of sleep deprivation on symptoms of psychopathology in healthy adults. *Sleep Medicine, 8*(3), 215–221.

Kammerer, M. K., Bott, A., Strakeljahn, F., & Lincoln, T. M. (2024). Sleep spindle activity and psychotic experiences: Examining the mediating roles of attentional performance and perceptual distortions in a daytime nap study. *Sleep Medicine, 116*(February), 43–50. https://doi.org/10.1016/j.sleep.2024.02.023

Kammerer, M. K., Bub, K., & Lincoln, T. M. (2021). The relationship between nightmares and psychotic experiences in young adults. *Sleep Medicine, 77*, 315–322. https://doi.org/10.1016/j.sleep.2020.08.014

Kammerer, M. K., Mehl, S., Ludwig, L., & Lincoln, T. M. (2021). Sleep and circadian rhythm disruption predict persecutory symptom severity in day-to-day life: A combined actigraphy and experience sampling study. *Journal of Abnormal Psychology, 130*(1 PG-78–88), 78–88. https://doi.org/10.1037/abn0000645

Kasanova, Z., Hajdúk, M., Thewissen, V., & Myin-Germeys, I. (2020). Temporal associations between sleep quality and paranoia across the paranoia continuum: An experience sampling study. *Journal of Abnormal Psychology, 129*(1), 122–130. https://doi.org/10.1037/abn0000453

Kay, S. R. (1991). *Positive and negative syndromes in schizophrenia: Assessment and research (issue 5)*. Psychology Press.

Kessler, R. C., & Wang, P. S. (2008). The descriptive epidemiology of commonly occurring mental disorders in the United States. *Annual Review of Public Health, 29*, 115–129. https://doi.org/10.1146/annurev.publhealth.29.020907.090847

Koyanagi, A., & Stickley, A. (2015). The association between sleep problems and psychotic symptoms in the general population: A global perspective. *Sleep, 38*(12), 1875–1885. https://doi.org/10.5665/sleep.5232

Kraepelin, E. (1919). In R. Barclay, & G. Robertson (Eds.), *Dementia praecox and paraphrenia*. Chicago Medical Book Co.

Levin, R., & Fireman, G. (2002). Nightmare prevalence, nightmare distress, and self-reported psychological disturbance. *Sleep, 25*(2), 205–212.

Lüdtke, T., Pfuhl, G., Moritz, S., Rüegg, N. L., Berger, T., & Westermann, S. (2021). Sleep problems and worrying precede psychotic symptoms during an online intervention for psychosis. *British Journal of Clinical Psychology, 60*(1), 48–67. https://doi.org/10.1111/bjc.12270

Meyer, N., Joyce, D. W., Karr, C., de Vos, M., Dijk, D. J., Jacobson, N. C., & MacCabe, J. H. (2022). The temporal dyanmics of sleep disturbance and psychopathology in psychosis: a digital sampling study. *Psychological Medicine, 52*(13), 2741–2750.

Meyhöfer, I., Kumari, V., Hill, A., Petrovsky, N., & Ettinger, U. (2017). Sleep deprivation as an experimental model system for psychosis: Effects on smooth pursuit, prosaccades, and antisaccades. *Journal of Psychopharmacology, 31*(4), 418–433. https://doi.org/10.1177/0269881116675511

Meyhöfer, I., Steffens, M., Faiola, E., Kasparbauer, A., Kumari, V., & Ettinger, U. (2017). Combining two model systems of psychosis: The effects of schizotypy and sleep deprivation on oculomotor control and psychotomimetic states. *Psychophysiology, 54*, 1755–1769, 11 PG-1755–1769.

Mulligan, L. D., Haddock, G., Emsley, R., Neil, S. T., & Kyle, S. D. (2016). High resolution examination of the role of sleep disturbance in predicting functioning and psychotic symptoms in schizophrenia: A novel experience sampling study. *Journal of Abnormal Psychology, 125*(6), 788–797. https://doi.org/10.1037/abn0000180

Myers, E., Startup, H., & Freeman, D. (2011). Cognitive behavioural treatment of insomnia in individuals with persistent persecutory delusions: A pilot trial. *Journal of Behavior Therapy and Experimental Psychiatry, 42*(3), 330–336. https://doi.org/10.1016/j.jbtep.2011.02.004

Orwin, R. G. (1983). A fail-safe N for effect size in meta-analysis. *Journal of Educational Statistics, 8*(2), 157–159.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, 2020–2021. https://doi.org/10.1136/bmj.n71

Petrovsky, N., Ettinger, U., Hill, A., Frenzel, L., Meyhofer, I., Wagner, M., & ...& Kumari, V. (2014). Sleep deprivation disrupts prepulse inhibition and induces psychosis-like symptoms in healthy humans. *Journal of neuroscience, 34*(27), 9134–9140.

Reeve, S., Emsley, R., Sheaves, B., & Freeman, D. (2017). *Disrupting sleep: The effects of sleep loss on psychotic experiences tested in an experimental study with mediation analysis* (pp. 1–10). Schizophrenia Bulletin. https://doi.org/10.1093/schbul/sbx103

Reeve, S., Nickless, A., Sheaves, B., & Freeman, D. (2018). Insomnia, negative affect, and psychotic experiences: modelling pathways over time in a clinical observational study. *Psychiatry Research, 269*, 673–680.

Reeve, S., Nickless, A., Sheaves, B., Hodgekins, J., Stewart, S. L. K., Gumley, A., … Freeman, D. (2019). Sleep duration and psychotic experiences in patients at risk of psychosis: A secondary analysis of the EDIE-2 trial. *Schizophrenia Research, 204*, 326–333. https://doi.org/10.1016/j.schres.2018.08.006

Reeve, S., Sheaves, B., & Freeman, D. (2015). The role of sleep dysfunction in the occurrence of delusions and hallucinations: A systematic review. *Clinical Psychology Review, 42*, 96–115. https://doi.org/10.1016/j.cpr.2015.09.001

Reeve, S., Sheaves, B., & Freeman, D. (2019). Sleep disorders in early psychosis: Incidence, severity, and association with clinical symptoms. *Schizophrenia Bulletin, 45*(2 PG-287–295), 287–295. https://doi.org/10.1093/schbul/sby129

Rehman, A., Gumley, A., & Biello, S. (2018). Sleep quality and paranoia: The role of alexithymia, negative emotions and perceptual anomalies. *Psychiatry Research, 259*(April 2016), 216–222. https://doi.org/10.1016/j.psychres.2017.09.066

Rek, S., Sheaves, B., & Freeman, D. (2017). Nightmares in the general population: Identifying potential causal factors. *Social Psychiatry and Psychiatric Epidemiology, 52*, 1123–1133. PG-1123-1133.

Ronald, A., Sieradzka, D., Cardno, A. G., Haworth, C. M. A., Mcguire, P., & Freeman, D. (2014). Characterization of psychotic experiences in adolescence using the specific psychotic experiences questionnaire: Findings from a study of 5000 16-year-old twins. *Schizophrenia Bulletin, 40*(4), 868–877. https://doi.org/10.1093/schbul/sbt106

Scott, A. J., Rowse, G., & Webb, T. L. (2017). A structural equation model of the relationship between insomnia, negative affect, and paranoid thinking. *PLoS One, 12*. https://doi.org/10.1371/journal.pone.0186233, 10 PG.

Sheaves, B., Holmes, E. A., Rek, S., Taylor, K. M., Nickless, A., Waite, F., … Freeman, D. (2019). Cognitive behavioural therapy for nightmares for patients with persecutory delusions (nites): An assessor-blind, pilot randomized controlled trial. *The Canadian journal of psychiatry / La revue Canadienne de Psychiatrie, 64*, 686–696, 10 PG-686–696. (NS -).

Sheaves, B., Onwumere, J., Keen, N., & Kuipers, E. (2015). Treating your worst nightmare: A case-series of imagery rehearsal therapy for nightmares in individuals experiencing psychotic symptoms. *The Cognitive Behaviour Therapist, 8*.

Sheaves, B., Porcheret, K., Tsanas, A., Espie, C. A., Foster, R. G., Freeman, D., … Goodwin, G. M. (2016). Insomnia, nightmares, and chronotype as markers of risk for severe mental illness: Results from a student population. *Sleep, 39*(1 PG-173–181), 173–181 (NS -).

Shevlin, M., McElroy, E., Bentall, R. P., Reininghaus, U., & Murphy, J. (2017). The psychosis continuum: Testing a bifactor model of psychosis in a general population sample. *Schizophrenia Bulletin, 43*(1), 133–141. https://doi.org/10.1093/schbul/sbw067

Spoormaker, V. I., Verbeek, I., van den Bout, J., & Klip, E. C. (2005). Initial validation of the SLEEP-50 questionnaire. *Behavioral Sleep Medicine, 3*(4), 227–246.

Taylor, K. M., Bradley, J., & Cella, M. (2022). A novel smartphone-based intervention targeting sleep difficulties in individuals experiencing psychosis: A feasibility and acceptability evaluation. *Psychology and Psychotherapy: Theory, Research and Practice, 95*(3), 717–737. https://doi.org/10.1111/papt.12395

Taylor, M. J., Gregory, A. M., Freeman, D., & Ronald, A. (2015). Do sleep disturbances and psychotic-like experiences in adolescence share genetic and environmental influences? *Journal of Abnormal Psychology, 124*(3 PG-674–684), 674–684. https://doi.org/10.1037/abn0000057

Waite, F., Černis, E., Kabir, T., Iredale, E., Johns, L., Maughan, D., … Yu, L.-M. (2023). A targeted psychological treatment for sleep problems in young people at ultra-high risk of psychosis in England (SleepWell): A parallel group, single-blind, randomised controlled feasibility trial. *The Lancet Psychiatry, 10*(9), 706–718.

Wigman, J. T. W., Vollebergh, W. A. M., Raaijmakers, Q. A. W., Iedema, J., Van Dorsselaer, S., Ormel, J., … Van Os, J. (2009). The structure of the extended psychosis phenotype in early adolescence—A cross-sample replication. *Schizophrenia Bulletin, 37*, 850–860. https://doi.org/10.1093/schbul/sbp154

Wong, K. K., Freeman, D., & Hughes, C. (2014). Suspicious young minds: Paranoia and mistrust in 8- to 14-year-olds in the UK and Hong Kong. *British Journal of Psychiatry, 205*(3), 221–229. https://doi.org/10.1192/bjp.bp.113.135467

Yung, A. R., Yung, A. R., Pan Yuen, H., Mcgorry, P. D., Phillips, L. J., Kelly, D., … Killackey, E. (2005). Mapping the onset of psychosis: The comprehensive assessment of at-risk mental states. *Australian & New Zealand Journal of Psychiatry, 39*(11–12), 964–971.

Zavos, H. M. S., Freeman, D., Haworth, C. M. A., Mcguire, P., Plomin, R., Cardno, A. G., & Ronald, A. (2014). Consistent etiology of severe, frequent psychotic experiences and milder, less frequent manifestations: A twin study of specific psychotic experiences in adolescence objective—Investigate degree of genetic and environmental influences on specific psychoti. *JAMA Psychiatry, 71*(9), 1049–1057. https://doi.org/10.1001/jamapsychiatry.2014.994