Primary outcomes

At 6-month follow-up, the intervention group showed a larger change in SCI score (M = 4.89, SD = 6.02) than the control group (M = 2.05, SD = 6.80), with an effect size of d = 0.44. This difference was statistically significant, t (106) = 2.23, p = .027. When only participants that did not meet the threshold for insomnia at baseline were considered (n = 71) a similar effect size was found d = 0.55. The effect size was smaller for participants who did meet the insomnia threshold at baseline (d = 0.22) (n = 35).

A total of 67% of participants in the intervention group had a change score above the mean of the control group (Cohen's U_3). There was an overlap of 82%, and the probability that a person picked at random from the intervention group had a higher score than a person picked at random from the control group was 62%.

Within the intervention group, there was a significant reduction (by 21%) in the number of participants who met insomnia disorder threshold score at the 6-month follow up assessment, compared to baseline (baseline = 36%, 6-month follow-up= 15%), χ^2 (1) = 8.65, p = .003. In the control group, there was a non-significant 7% reduction (baseline = 28%, 6-month follow-up = 20%), χ^2 (1) = 1.00, p = .317. A total of 33% of participants in the intervention group met or exceeded the RCI of 7, and 27% of participants in the control group met or exceeded the RCI of 7 (χ^2 (1) = 0.60, p = .439).

A generalized estimating equation predicting change in SCI score from group, time, and the group x time interaction (with baseline SCI and age as covariates) showed a significant effect of group, with a larger change in SCI score in the intervention group compared to the control group (β = 1.88, 95% CI = 0.34 – 3.41, p = .017).

Secondary and exploratory outcomes

A set of generalizing estimating equations were performed to examine changes in associated variables across the course of the study. For these analyses, 6-month follow-up was added as an additional time point. Coefficients and 95% CI for the effect of group on change in

insomnia symptoms are shown in **Figure S1A**. Anxiety symptoms (β = -2.56, 95 % CI = -4.91 – -0.22, *p* = .032), experience of hallucinations (β = -1.14, 95% CI = -2.11 – -0.16, *p* = .022), and perceived stress (β = -2.07, 95% CI = -3.88 – -0.26, *p* = .025) were all reduced in the intervention group compared to the control.

Group * moderator interactions are shown in **Figure S1B**. Baseline anxiety symptoms showed the largest co-efficient size (β = 0.73, 95% CI = 0.10 – 1.55). The combined moderator (a composite of all other moderators, based on the method of Kraemer, 2013) was the only term where the confidence intervals did not cross 0.

Mediated regressions were run to examine whether group membership predicting insomnia symptoms at the 6-month follow-up were mediated by other sleep-related variables (**Figure S1C**). Only dysfunctional beliefs about sleep showed clear evidence of an indirect effect (β = 1.11, 95% CI = 0.20 – 2.02)

Supplementary Table 1. Scale reliabilities

| Measure | Baseline | Scale reliabilities (α) | | |
		Mid-intervention	End of intervention	6-month follow-up
Demographics	N/A	N/A	N/A	N/A
SCI	.85	.88	.89	.86
STAI	.92	.93	.94	.93
MFQ	.91	.94	.91	.93
ADHD	.92	-	.93	.94
SPEQP	.91	-	.92	.91
SPEQH	.79	-	.89	.88
SPEQC	.63	-	.73	.82
PMH	.94	.95	.95	.95
PSS	.84	.90	.88	.90
LTE	.70	.61	.63	.63
PSQI	.69	.63	.64	.69
PSQIA	.69	-	.72	.76
PSASS	.82	.87	.82	.90
PSASC	.89	.92	.91	.92
DBAS	.78	.82	.88	.84
MCTQ	N/A	-	N/A	N/A
TAQ	-	.61	.73	-

Note. α = Cronbach's alpha

SCI = Sleep condition indicator; STAI = State trait anxiety index (trait); MFQ = Mood and feelings questionnaire; ADHD = Attention deficit hyperactivity disorder symptoms; SPEQP = Specific psychotic experiences questionnaire paranoia subscale; SPEQH = Specific psychotic experiences questionnaire hallucinations subscale; SPEQC = Specific psychotic experiences questionnaire cognitive disorganization subscale; PMH = Positive mental health scale; PSS = Perceived stress scale; LTE = List of threatening events; PSQI = Pittsburgh sleep quality index, PSQIA = Pittsburgh sleep quality index addendum; PSASS = Pre-sleep arousal scale somatic subscale; PSASC = Pre-sleep arousal scale cognitive subscale; DBAS = Dysfunctional beliefs about sleep questionnaire; MCTQ = Munich chronotype questionnaire; TAQ = Treatment acceptability questionnaire

Supplementary Table 2. Generalized estimating equation assessing change in SCI score over time

Predictor	β	95% CI	p-value
[DV: SCI score over time]			
Group [reference: Control]			
Intervention	1.94	0.42 – 3.47	**.013**
Time [reference: Mid-intervention)			
End of intervention	1.61	0.40 – 2.82	**.009**
Group x time interaction			
Intervention x end of intervention	0.18	-1.54 – 1.90	.838
<u>Co-variates</u>			
Baseline SCI score	5.18	4.48 – 5.87	**< .001**
Age	-0.01	-0.22 – 0.20	.903

Note. β = Co-efficient, CI = Confidence intervals, SCI = Sleep condition indicator

For the effect of group, the co-efficient indicates change in SCI score across time in the intervention group *compared* to the control group. For the effect of time, co-efficients indicate change in SCI score at end of intervention and 6-month follow *compared* to the mid-intervention. For the group x time interaction, the control group and mid-intervention time points are used as the references.

Supplementary Table 3. Generalized estimating equation models for changes in variables across the intervention

Predictor variables	Model information		
Anxiety symptoms			
DV: Anxiety symptoms			
	β	95% CI	p-value
Group [reference: Control]			
Intervention	-2.58	-4.90 – -0.25	**.030**
Time [reference: Mid-intervention)			
End of intervention	-1.74	-3.10 – -0.39	**.012**
Group x time interaction			
Intervention x end of intervention	-0.47	-2.57 – 1.62	.658
Co-variates			
Baseline insomnia symptoms	-0.87	-2.05 – 0.32	.152
Baseline anxiety symptoms	7.76	6.32 – 9.19	**< .001**
Age	-0.27	-0.57 – 0.03	.077
Depression symptoms			
DV: Depression symptoms			
	β	95% CI	p-value
Group [reference: Control]			
Intervention	-0.63	-2.24 – 1.01	.456
Time [reference: Mid-intervention)			
End of intervention	-1.83	-2.99 – -0.68	**.002**
Group x time interaction			
Intervention x end of intervention	-0.09	-1.79 – 1.62	.920
Co-variates			
Baseline insomnia symptoms	-0.95	-1.74 – -0.17	**.017**
Baseline depression symptoms	3.83	3.06 – 4.59	**< .001**
Age	-0.18	-0.31 – -005	**.006**
ADHD symptoms			
DV: ADHD symptoms			
	β	95% CI	p-value
Group [reference: Control]			
Intervention	-2.34	-5.21 – 0.53	.110
Co-variates			
Baseline insomnia symptoms	-1.27	-2.93 – 0.39	.135
Baseline ADHD symptoms	8.14	6.62 – 9.66	**< .001**
Age	-0.23	-0.49 – 0.02	.073

Psychotic experiences – Paranoia

DV: Experiences of paranoia

	β	95% CI	p-value
Group [reference: Control]			
Intervention	-1.69	-3.31 – -0.07	**.041**
Co-variates			
Baseline insomnia symptoms	-0.92	-1.95 – 0.12	.082
Baseline experiences of paranoia	2.86	1.93 – 3.80	**< .001**
Age	-0.14	-0.35 – 0.06	.183

Psychotic experiences – Hallucinations

DV: Experiences of hallucinations

	β	95% CI	p-value
Group [reference: Control]			
Intervention	-0.22	-0.92 – 0.48	.531
Co-variates			
Baseline insomnia symptoms	-0.24	-0.71 – 0.23	.316
Baseline experiences of hallucinations	1.56	0.64 – 2.49	**.001**
Age	-0.06	-0.12 – -0.01	**.017**

Psychotic experiences – Cognitive disorganization

DV: Cognitive disorganization

	β	95% CI	p-value
Group [reference: Control]			
Intervention	-0.37	-0.84 – 0.11	.130
Co-variates			
Baseline insomnia symptoms	-0.17	-0.44 – -0.10	.214
Baseline cognitive disorganization	0.82	0.59 – 1.05	**< .001**
Age	-0.09	-0.14 – -0.03	**.004**

Positive mental health

DV: Positive mental health

	β	95% CI	p-value
Group [reference: Control]			
Intervention	0.07	-1.17 – 1.30	.916
Time [reference: Mid-intervention)			
End of intervention	1.18	0.38 – 1.98	**.004**
Group x time interaction			

Intervention x end of intervention	-0.36	-1.48 – 0.76	.525
Co-variates			
Baseline insomnia symptoms	0.35	-0.18 – 0.88	.202
Baseline positive mental health	4.78	4.21 – 5.34	**< .001**
Age	-0.01	-0.15 – 0.13	.881

Perceived stress

DV: Perceived stress

	β	95% CI	p-value
Group [reference: Control]			
Intervention	-2.03	-3.83 – -0.23	**.027**
Time [reference: Mid-intervention)			
End of intervention	-2.19	-3.56 – -0.81	**.002**
Group x time interaction			
Intervention x end of intervention	1.30	-0.43 – 3.03	.140
Co-variates			
Baseline insomnia symptoms	-0.86	-1.89 – 0.17	.101
Baseline perceived stress	4.79	3.96 – 5.62	**< .001**
Age	-0.09	-0.26 – 0.09	.326

Note. CI = Confidence interval

For the effect of group, the co-efficient indicates change in DV score across time in the intervention group *compared* to the control group. For the effect of time, coefficients indicate change in DV score at end of intervention and 6-month follow *compared* to the mid-intervention. For the group x time interaction, the control group and mid-intervention time points are used as the references. For ADHD symptoms , experiences of paranoia, experiences of hallucinations and cognitive disorganization, no time or group x time as measure was not assessed at mid-intervention.

Supplementary Table 3. Regression models for moderators of treatment outcome

Predictor variables	Model information		
DV: insomnia symptoms at end of treatment			
Anxiety symptoms			
	β	95% CI	p-value
Group	1.87	0.01 – 3.74	**.049**
Baseline anxiety symptoms	-0.88	-2.40 – 0.64	.254
Group * baseline anxiety symptoms	0.54	-1.33 – 2.40	.572
Age	0.17	-0.06 – 0.41	.150
Baseline insomnia symptoms	3.85	2.76 – 4.93	**< .001**
Depression symptoms			
	β	95% CI	p-value
Group	1.86	-0.02 – 3.75	.054
Baseline depression symptoms	0.09	1.42 – 1.61	.903
Group * baseline depression symptoms	0.08	-1.82 – 1.98	.934
Age	0.02	-0.19 – 0.22	.877
Baseline insomnia symptoms	4.21	3.08 – 5.34	**< .001**
ADHD symptoms			
	β	95% CI	p-value
Group	1.93	0.06 – 3.80	**.043**
Baseline ADHD symptoms	0.13	-1.13 – 1.39	.841
Group * baseline ADHD symptoms	1.07	-0.76 – 2.89	.253
Age	0.01	-0.19 – 0.21	.921
Baseline insomnia symptoms	4.27	3.31 – 5.24	**< .001**
Psychotic experiences - paranoia			
	β	95% CI	p-value
Group	1.93	0.05 – 3.82	**.044**
Baseline experiences of paranoia	-0.58	-2.01 – 0.86	.430
Group * baseline experiences of paranoia	1.20	-0.70 – 3.10	.215
Age	0.01	-0.20 – 0.21	.957
Baseline insomnia symptoms	4.15	3.12 – 5.18	**< .001**
Psychotic experiences - hallucinations			
	β	95% CI	p-value
Group	1.96	0.07 – 3.86	**.042**
Baseline experiences of hallucinations	-0.93	-2.58 – 0.72	.267
Group * baseline experiences of hallucinations	1.14	-0.83 – 3.11	.254
Age	0.01	-0.20 – 0.21	.988
Baseline insomnia symptoms	4.03	3.03 – 5.03	**< .001**

Psychotic experiences – cognitive disorganization

	β	95% CI	p-value
Group	1.94	0.07 – 3.82	**.043**
Baseline cognitive disorganization	0.79	-0.54 – 2.12	.242
Group * baseline cognitive disorganization	-0.27	-2.13 – 1.59	.778
Age	0.03	-0.17 – 0.23	.774
Baseline insomnia symptoms	4.23	3.26 – 5.19	**< .001**

Positive mental health

	β	95% CI	p-value
Group	1.91	0.02 – 3.81	**.048**
Baseline positive mental health	0.48	-1.08 – 2.03	.543
Group * positive mental health	-0.25	-2.16 – 1.67	.800
Age	0.01	-0.20 – 0.21	.959
Baseline insomnia symptoms	4.00	2.95 – 5.05	**< .001**

Perceived stress

	β	95% CI	p-value
Group	1.72	-0.15 – 3.59	.070
Baseline perceived stress	-0.53	-1.94 – 0.88	.456
Group * baseline perceived stress	0.59	-1.25 – 2.44	.525
Age	0.17	-0.07 – 0.41	.159
Baseline insomnia symptoms	4.08	3.02 – 5.14	**< .001**

Threatening life events

	β	95% CI	p-value
Group	1.91	0.03 – 3.80	**.047**
Baseline threatening life events	0.12	-1.10 – 1.33	.849
Group * threatening life events	0.55	-1.30 – 2.39	.561
Age	0.01	-0.19 – 0.22	.896
Baseline insomnia symptoms	4.17	3.17 – 5.17	**< .001**

Combined moderator

	β	95% CI	p-value
Group	1.73	-0.17 – 3.62	.074
Combined moderator	-0.61	-2.25 – 1.04	.467
Group * combined moderator	0.97	-1.12 – 3.05	.362
Age	0.18	-0.07 – 0.42	.152
Baseline insomnia symptoms	4.21	3.22 – 5.20	**< .001**

Note: SCI = Sleep condition indicator, CI = Confidence intervals

Supplementary Table 5. Bootstrapped mediated regression models for potential mediators of outcome at end of intervention

Predictor	Model information		

DV: insomnia symptoms at end of intervention

Mediator: General sleep quality

Group predicting insomnia symptoms

	B	95% CI	p-value
Group	1.86	-0.28 – 4.00	.088
Baseline insomnia symptoms	4.05	2.43 – 5.68	**< .001**
Baseline general sleep quality	-0.79	-2.43 – 0.85	.342
Age	-0.03	-0.23 – 0.17	.742

Group predicting general sleep quality

	B	95% CI	p-value
Group	-0.30	-0.66 – 0.05	.093
Baseline insomnia symptoms	-0.22	-0.49 – 0.05	.114
Baseline general sleep quality	0.44	0.16 – 0.71	**.002**
Age	-0.22	-0.49 – 0.05	.464

Group and general sleep quality predicting insomnia symptoms

	B	95% CI	p-value
General sleep quality at end of intervention	-4.73	-5.54 – -3.93	**< .001**
Group	0.43	-0.93 – 1.78	.535
Baseline insomnia symptoms	3.03	2.00 – 4.05	**< .001**
Baseline general sleep quality	1.27	0.19 – 2.35	**.022**
Age	0.02	-0.10 – 0.15	.695
Indirect effect	1.43	-0.12 – 3.24[1]	

Mediator: Cognitions about sleep

Group predicting insomnia symptoms

	B	95% CI	p-value
Group	1.98	0.21 – 3.75	**.029**
Baseline insomnia symptoms	4.42	3.43 – 5.40	**< .001**
Baseline cognitions about sleep	-0.11	-1.09 – 0.87	.823
Age	0.02	-0.17 – 0.21	.833

Group predicting cognitions about sleep

	β	95% CI	p-value
Group	-0.53	-0.80 – -0.26	**< .001**
Baseline insomnia symptoms	-0.12	-0.27 – 0.28	.110
Baseline cognitions about sleep	0.54	0.39 – 0.68	**< .001**
Age	-0.01	-0.04 – 0.02	.583

<u>Group and cognitions about sleep predicting insomnia symptoms</u>

	β	95% CI	p-value
Cognitions about sleep at end of intervention	-2.67	-3.69 – -1.64	**< .001**
Group	0.57	-1.14 – 2.29	.509
Baseline insomnia symptoms	4.09	3.18 – 5.00	**< .001**
Baseline cognitions about sleep	1.32	0.26 – 2.37	**.015**
Age	-0.01	-0.17 – 0.17	.990
Indirect effect	1.41	0.69 – 2.37[1]	

<u>Mediator: Somatic pre-sleep arousal</u>

<u>Group predicting insomnia symptoms</u>

	β	95% CI	p-value
Group	2.14	0.39 – 3.89	**.017**
Baseline insomnia symptoms	4.57	3.56 – 5.57	.792
Baseline somatic pre-sleep arousal	0.15	-0.85 – 1.15	.766
Age	0.03	-0.16 – 0.21	.792

<u>Group predicting somatic pre-sleep arousal</u>

	β	95% CI	p-value
Group	-0.39	-0.65 – 0.12	**.005**
Baseline insomnia symptoms	-0.28	-0.43 – -0.12	**.001**
Baseline somatic pre-sleep arousal	0.41	0.25 – 0.56	**< .001**
Age	-0.03	-0.06 – 0.01	.066

<u>Group and somatic pre-sleep arousal predicting insomnia symptoms</u>

	β	95% CI	p-value
Somatic pre-sleep arousal at end of intervention	-3.11	-4.09 – -2.13	**< .001**
Group	0.94	-0.65 – 2.54	.245
Baseline insomnia symptoms	3.71	2.78 – 4.64	**< .001**
Baseline somatic pre-sleep arousal	1.42	0.45 – 2.39	**.004**
Age	-0.06	-0.23 – 0.11	.494
Indirect effect	1.20	0.47 – 2.30[1]	

<u>Mediator: Cognitive pre-sleep arousal</u>

<u>Group predicting insomnia symptoms</u>

	β	95% CI	p-value
Group	1.98	0.17 – 3.69	**.024**
Baseline insomnia symptoms	4.47	3.41 – 5.54	**< .001**
Baseline cognitive pre-sleep arousal	-0.06	-1.10 – 0.98	.907
Age	0.19	-0.03 – 0.41	.088

<u>Group predicting cognitive pre-sleep arousal</u>

	β	95% CI	p-value
Group	-0.16	-0.44 – 0.12	.250

	β	95% CI	p-value
Baseline insomnia symptoms	-0.24	-0.41 – -0.07	**.007**
Baseline cognitive pre-sleep arousal	0.40	0.24 – 0.57	**< .001**
Age	-0.01	-0.42 – 0.03	.691

Group and cognitive pre-sleep arousal predicting
insomnia symptoms

	β	95% CI	p-value
Cognitive pre-sleep arousal at end of intervention	-3.13	-4.03 – -2.22	**< .001**
Group	1.47	-0.01 – 2.96	.052
Baseline insomnia symptoms	3.72	2.78 – 4.67	**< .001**
Baseline cognitive pre-sleep arousal	1.20	0.23 – 2.18	**.016**
Age	0.17	-0.02 – 0.36	.082
Indirect effect	0.51	-0.27 – 1.46[1]	

Mediator: Specific sleep disturbances

Group predicting insomnia symptoms

	β	95% CI	p-value
Group	2.26	0.54 – 3.99	**.011**
Baseline insomnia symptoms	3.85	2.81 – 4.89	**< .001**
Baseline specific sleep disturbances	-1.21	-2.27 – -0.14	**.027**
Age	0.01	-0.18 – 0.19	.986

Group predicting specific sleep disturbances

	B	95% CI	p-value
Group	-0.04	-0.32 – 0.23	.770
Baseline insomnia symptoms	-0.09	-0.25 – 0.08	.311
Baseline specific sleep disturbances	0.56	-0.39 – 0.73	**< .001**
Age	-0.01	-0.04 – 0.02	.496

Group and specific sleep disturbances predicting
insomnia symptoms

	β	95% CI	p-value
Specific sleep disturbances at end of intervention	-2.36	-3.35 – -1.38	**< .001**
Group	2.16	0.56 – 3.77	**.009**
Baseline insomnia symptoms	3.65	2.68 – 4.62	**<.001**
Baseline specific sleep disturbances	0.12	-1.02 – 1.25	.841
Age	-0.02	-0.20 – 0.15	.798
Indirect effect	0.10	-0.47 – 0.88[1]	

Mediator: Chronotype

Group predicting insomnia symptoms

	β	95% CI	p-value
Group	1.26	-2.25 – 4.74	.475
Baseline insomnia symptoms	4.71	2.81 – 6.61	**< .001**
Baseline chronotype	-0.97	-1.16 – 1.20	.370
Age	-0.02	-0.39 – 0.35	.926

<u>Group predicting chronotype</u>

	β	95% CI	p-value
Group	-0.12	-0.48 – 0.24	.493
Baseline insomnia symptoms	2.30	-3.64 – 1.57	.706
Baseline chronotype	0.21	-0.01 – 0.44	.058
Age	2.56	-3.52 – 4.04	.892

<u>Group and chronotype predicting insomnia symptoms</u>

	β	95% CI	p-value
Chronotype at end of intervention	1.39	-1.80 – 4.57	.383
Group	1.41	-2.11 – 4.95	.422
Baseline insomnia symptoms	4.66	2.75 – 6.57	**< .001**
Baseline chronotype	-1.28	-3.57 – 1.02	.267
Age	-0.06	-0.37 – 0.25	.688
Indirect effect	-0.17	-1.51 – 1.20[1]	

Note. CI = Confidence interval

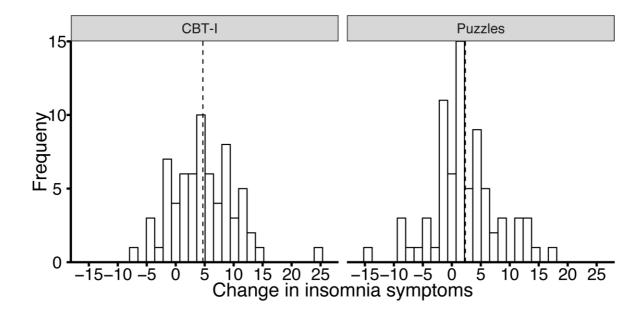[1] Bias-corrected confidence interval derived from bootstrapping (5000 repetitions)

Figure S1. Change in insomnia symptoms from baseline to the end of the intervention. Dashed lines show the mean change.
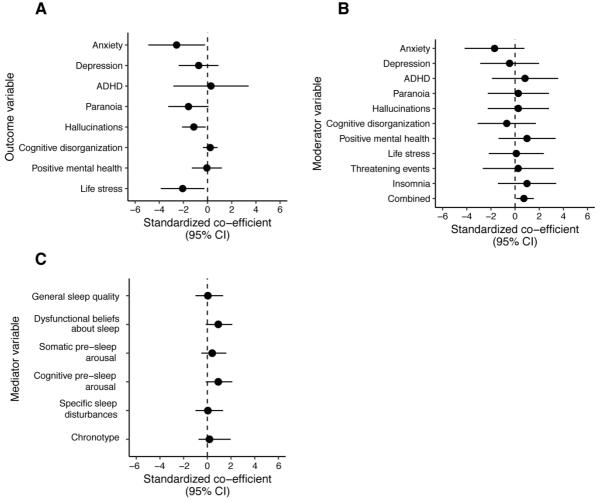
Figure S2 Changes in associated variables, moderation, and mediation results at 6-month follow-up. Control group is always used as the reference. **A** – Changes in associated variables: Standardized coefficients and 95% confidence intervals for the effect of group for each associated variable on the change in insomnia symptoms from baseline to 6-month follow-up. **B** – Moderation: Standardized coefficients and 95% confidence intervals for each of the individual group * baseline predictor interactions and the group * combined moderator interaction for each potential moderator of insomnia symptoms at 6-month follow-up. **C** – Mediation: Standardized coefficients and bias-corrected 95% confidence intervals for each potential mediator of insomnia symptoms at 6-month follow-up.