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Effectiveness of an online recovery training for employees exposed to blurred boundaries between work and non-work: Bayesian analysis of a randomised controlled trial

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ABSTRACT

Background Blurred work–non-work boundaries can have negative effects on mental health, including sleep.
Objectives In a randomised control trial, we aimed to assess the effectiveness of an online recovery training programme designed to improve symptoms of insomnia in a working population exposed to blurred boundaries.
Methods 128 participants with severe insomnia symptoms (Insomnia Severity Index ≥15) and working under blurred work and non-work conditions (segmentation supplies <2.25) were randomly assigned to either the recovery intervention or a waitlist control group (WLC). The primary outcome was insomnia severity, assessed at baseline, after 2 months (T2) and 6 months (T3).
Findings A greater reduction in insomnia was observed in the intervention compared with the WLC group at both T2 (d=1.51; 95% CI=1.12 o 1.91) and T3 (d=1.63; 95% CI=1.23 to 2.03]. This was shown by Bayesian analysis of covariance (ANCOVA), whereby the ANCOVA model yielded the highest Bayes factor (BF_{10}=3.23×e^{60}] and a 99.99% probability. Likewise, frequentist analysis revealed significantly reduced insomnia at both T2 and T3. Beneficial effects were found for secondary outcomes including depression, work-related rumination, and mental detachment from work. Study attrition was 16% at T2 and 44% at T3.
Conclusions The recovery training was effective in reducing insomnia symptoms, work related and general indicators of mental health in employees exposed to blurred boundaries, both at T2 and T3.
Clinical implications In addition to demonstrating the intervention's effectiveness, this study exemplifies the utilisation of the Bayesian approach in a clinical context and shows its potential to empower recipients of interventional research by offering insights into result probabilities, enabling them to draw informed conclusions.
Trial registration number German Clinical Trial Registration (DRKS): DRKS00006223, https://drks.de/search/de/trial/DRKS00006223

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Blurred work–non-work boundaries are assumed to impact work-related cognitive hyperarousal and sleep.

WHAT THIS STUDY ADDS

⇒ For the first time, it is shown, that an online recovery training is effective in reducing insomnia severity in workers exposed to low segmentation supplies.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The training could be part of a comprehensive approach to occupational health and safety, protecting workers from the negative effects of blurred work–non-work interfaces.

BACKGROUND

Sleep problems have emerged as a substantial concern, impacting roughly 30% of the global population in Western industrialised regions, with insomnia affecting approximately 10%.[1] The prevalence of subclinical insomnia varies in the working population, ranging from 7% to 37% across different European countries.[2] Evidence from meta-analyses shows the negative effects of impaired sleep on overall work performance, including counterproductive work behaviour and suboptimal task performance.[3] Also, the workplace itself can significantly influence sleep quality and quantity, with factors like shift work, high job demands, effort-reward imbalance and job strain all contributing.[4] Impaired sleep, in turn, is known to be a risk factor for a variety of mental and physical disorders, including depression, anxiety disorders, cardiovascular disease and stroke.[5]

With major changes in work life over the last decade providing advantages like greater flexibility and autonomy for employees, the disadvantages of this development have also become more salient: Extended availability, thereby exposing employees to blurred boundaries between work and non-work, can negatively affect health-related outcomes; for example, through emotional exhaustion and poor sleep.[6] Depending on formal and informal policies, workplaces differ to the extent that they 'supply' the conditions and resources that enable a certain level

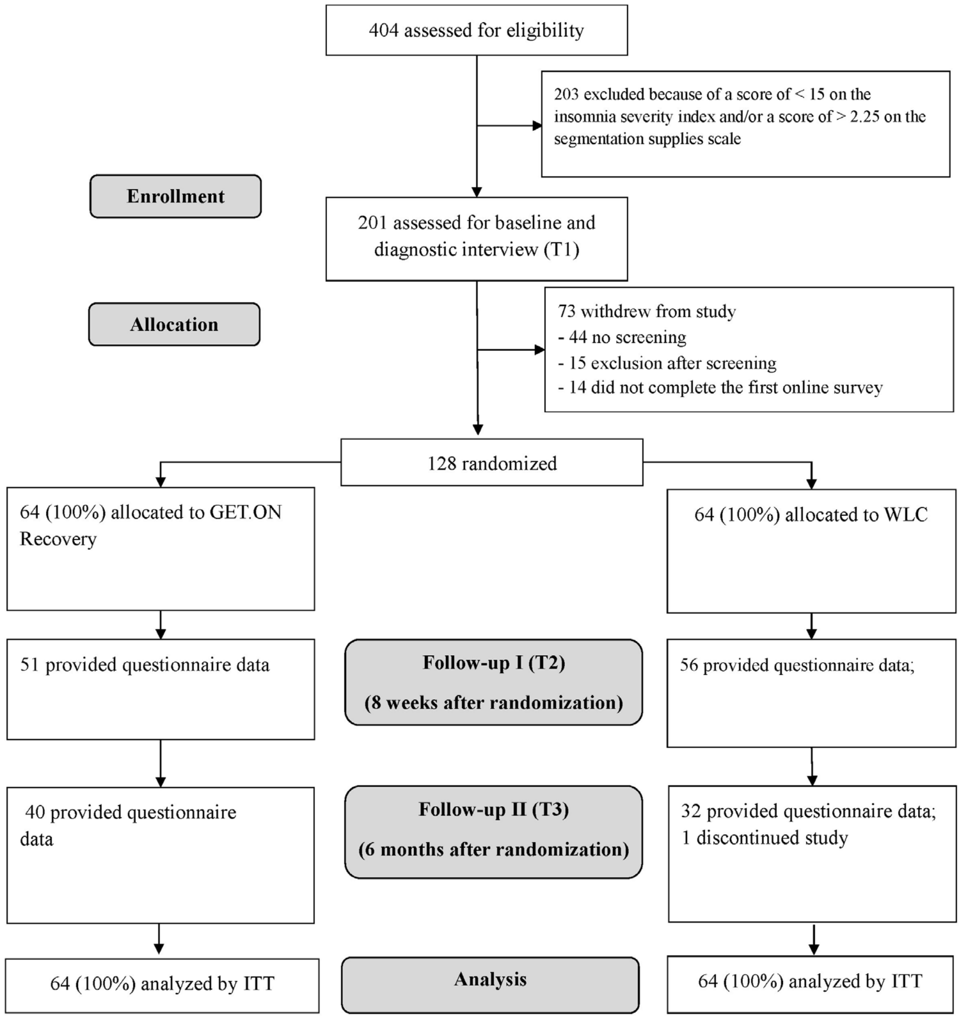

Figure 1 Flow of participants. ITT, intention-to-treat; WLC, waitlist control.

of work-home segregation or integration[7]: According to Kreiner, workplaces with low segmentation supplies are characterised by workers being required to engage in professional issues outside of actual working hours. Apart from the supplies, preferences for segmentation or integration of work and non-work can also vary between individuals.[8] Meanwhile, those working under low segmentation supply conditions report reduced mental detachment from work, irrespective of their personal preferences.[9] This adverse effect seems best explained by the constant mental representation of work-related stressors and continued involvement with work-related content, also known as 'rumination'.[10] In particular, work-related rumination is associated with prolonged physiological activation and high arousal, thereby making it difficult for employees to fall and remain asleep.[11] To prevent employees from developing or maintaining insomnia, it seems vital to develop skills that reduce work-related rumination, especially for those working in risky environments characterised by low segmentation supplies. Detachment, defined as an 'individual's sense of being away from the work situation',[12] is considered vital for recovery from work-related stressors.[13] While work-related rumination refers to the presence of arousing and sleep-inhibiting thoughts, mental detachment refers to their absence. In a recent meta-analysis by Karabinski *et al*,[14] several interventions were shown to reduce work-related rumination and increase mental detachment from work to almost the same extent. While no gold standard intervention for improving mental detachment was identifiable, several approaches seem to be effective; especially those that focus on combining mental detachment and sleep.

As such, it seems worthwhile to develop and evaluate interventions that address the interplay between low segmentation supplies, lack of mental detachment, the presence of work-related rumination and poor sleep. In general, strong evidence for positive effects on sleep has been found in a meta-analysis assessing cognitive–behavioural therapy for insomnia (CBT-I) delivered digitally in mostly clinical samples.[15] Nonetheless, to date, no evidence has been published to suggest that mental detachment and sleep can be improved in employees working in a low-segmentation-supply environment, using a digital intervention.

Objective

We evaluated the digital intervention 'GET.ON Recovery', which specifically targets employees exposed to blurred work and non-work boundaries. To the best of our knowledge, this is the first intervention to combine digital CBT-I and methods that focus on mental detachment from work-related problems, thereby promoting work-personal life separation and active recovery behaviours to foster better sleep. We hypothesised that GET.ON Recovery would lead to greater reductions in insomnia symptoms both right after the intervention and at 6-month follow-up relative to a waitlist control (WLC) condition that had full access to care as usual.

METHODS

Study design

This two-arm, parallel, randomised controlled trial (RCT)—comparing the internet-based intervention GET.ON Recovery with a WLC—was conducted at Leuphana University of Lüneburg and approved by the university's ethics committee. The study protocol was registered at the German Clinical Trials Registry and results are reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement for non-pharmacological treatment trials.[16] Outcomes were measured pretreatment (T1), immediately post-treatment (8 weeks, T2) and 4 months after the intervention was completed (6-month follow-up, T3).

For the sample size calculation, we considered previous meta-analyses on the effects of online CBT for insomnia[17] and the novelty of the intervention. Our calculation assumed an effect size of $d=0.5$ for the primary outcome post-intervention, which corresponds to 3 points on the Insomnia Severity Index (ISI). Thus, a sample of N=128 individuals was required to detect the assumed effect with $\alpha=0.05$ and $1\text{-}\beta = 0.80$ in a two-tailed test.

Participants and randomisation

Inclusion criteria were: (1) at least 18 years old; (2) currently employed and exposed to blurred boundaries between work and non-work, measured as a score <2.25 on the segmentation supplies scale, thereby one SD below the scale's mean value[7]; and (3) moderate insomnia, measured as a score≥15 on the ISI.[18]

Randomisation was performed by an independent researcher who was not involved in the study using the programme Randlist with a 1:1 ratio. After randomisation, participants were informed about their allocation by email and the intervention group received immediate access to the training programme. Meanwhile, the WLC had unrestricted access to treatment-as-usual and received access to the intervention after a waiting period of 6 months.

Procedures

Employees were informed about the intervention through various communication channels of a health insurance company to mimic real-life implementation, including printed magazines, email distribution lists, online postings and television announcements. It was emphasised that the intervention was aimed at employees who wanted to improve their sleep, mentally detach from work and actively recover. If interested, individuals could register for the study via a landing page for the training programme by leaving their email address and were asked to sign an informed consent form.

Intervention

The recovery training had already been tested in previous studies with school teachers[19 20] who were considered to experience blurred boundaries between work and non-work. However, in both these studies, low segmentation supplies were not measured empirically, which was an important limitation. The teacher-specific version was adapted to the general working population by changing the virtual personas of the intervention[21] and this version was used in the present study.

Training consisted of six modules, each averaging 45–60 min, which were completed independently by participants, though one module per week was recommended. The modules were based on iCBT-I (Internet-based Cognitive Behavioural Therapy for Insomnia) with a special focus on detachment, incorporating elements like psychoeducation about sleep and recovery, sleep hygiene, sleep restriction, relaxation and stimulus control, as well as boundary tactics to support mental detachment and cognitive methods to reduce hyperarousal. A detailed list of exercises promoting detachment and coping with low segmentation is available in the appendix (online supplemental table S1). The intervention group was provided with adherence-focused support, which means participants were supported in the completion of the intervention module by being sent email reminders and could ask for support from a trained coach after each completed module; though doing so was unnecessary for them to proceed to the next one.

Primary outcome measure

The primary outcome was insomnia severity, measured using the German version of the ISI.[18] This scale contains seven items, each answered on a 5-point scale (eg, 'How satisfied/dissatisfied are you with your current sleep pattern?', rated 0–4) with a total score ranging from 0 to 28. To detect a meaningful improvement or deterioration in insomnia severity from T1 to T2 and from T1 to T3, proposed change scores extracted from a study by Morin *et al*[22] were used; they considered an ISI score difference >4.6 points as a slight improvement in symptoms. The number needed to treat (NNT) was then calculated by comparing the two study groups. Symptom-free status also was assessed, corresponding to a score <8.

Secondary outcome measures

Depressive symptoms

Depression was assessed using the 'Center for Epidemiological Studies (CES) Depression Scale',[23] which has 20 items, with response options ranging from 0 to 3 and a total score ranging from 0 to 60.

Recuperation in sleep

The recuperation in sleep subscale, which is part of a questionnaire recommended as an outcome measure by the German Society of Sleep Medicine,[24] was used. Seven items were answered on a 5-point scale.

Worrying

Level of worry was measured using a 3-item short version of the Penn State Worry Questionnaire[25] adapted to the time frame 'past week', each having response options ranging from 0 to 6.

Work-related rumination

To measure work-related rumination, we used the cognitive irritation subscale of the Irritation Scale[26] with scores ranging from 1 to 7 for the three items.

Mental detachment

One subscale of the Recovery Experience Questionnaire with four items was used to assess mental detachment,[27] each answered on a 5-point scale.

Recovery activities

This was measured using the Recreation Experience Activity Questionnaire, which rates the frequency of recovery activities with 21 items.[21 28]

Table 1 Demographic characteristics: means/outcomes, SD/ percentages at baseline

	All (N=128)		Recovery (n=64)		Waitlist (n=64)	
Demographics	**N**	**%**	**n**	**%**	**n**	**%**
Socio-demographics						
Age (M/SD)	45.9	9.5	46.6	9.2	45.3	9.9
Married/partnership	86	67.2	45	70.3	41	64.1
Female	75	58.6	37	57.8	38	59.4
Having children	74	57.8	38	59.4	36	56.2
Education						
Less than high school	23	18.0	11	17.2	12	18.8
High school diploma	105	82.0	53	82.8	52	81.3
Employment						
Work experience, in years (M/SD)	19.8	10.8	19.3	11.1	20.2	10.6
Employed full-time	103	80.5	51	79.7	52	81.3
Managerial position	67	52.3	32	50.0	35	54.7
Previous experience with						
Mental health training	15	11.7	8	12.5	7	10.9
Psychotherapy	33	25.7	17	26.6	16	25.0
Psychotherapy for sleeping problems	10	5.5	4	6.3	3	4.7

Recovery, GET.ON Recovery.

Work-home interaction

We assessed positive and negative Work-Home and Home-Work-Interference using the 'Survey Work-Home Interaction'[29] questionnaire, whose subscales consist of four to eight items, each answered on a 4-point scale. The psychometric properties of the used questionnaires are presented in online supplemental table S2 .

Data analysis

Data were analysed according to the intention-to-treat principle. Bayesian analysis of covariance (ANCOVA) was performed to assess the intervention's effectiveness. Over the past few years, Bayesian inference has grown in popularity, with Bayesian methods being used more frequently in health sciences.[30] Despite the numerous advantages attributed to Bayesian inference, it often plays a subordinate role in analysing mental health interventions, particularly in RCT evaluations. Notable advantages of the Bayesian approach involve the opportunity of systematically incorporating prior knowledge into the analysis, and quantifying the strength of evidence in favour of a hypothesis.

Although the potential benefits of incorporating prior knowledge into Bayesian analysis are widely recognised, its practical realisation is often criticised. In particular, the estimation of prior knowledge is often criticised as weak, arbitrary and uninformed.[31] To overcome this serious limitation, in our Bayesian analysis, we were able to use the results of three trials of the same intervention as an informed prior.[19–21] To test our hypothesis, the Bayes factor (*BF*) was used to quantify the evidence for the different tested models.[32] *BF*s are expressed in terms of the relative strength of evidence when comparing two hypotheses, given the data and prior expectations about the parameters. When dealing with the concepts of the null hypothesis (ie, the parameter value is indeed 0) and a broad alternative hypothesis (ie, the parameter value differs from 0), the *BF* quantifies the relative evidence for or against these hypotheses, by presenting it as a ratio, akin to odds: For instance, if the statistical evidence strongly supports the alternative hypothesis, say 100 times more than the null, it is denoted as BF_{10}=100. The '$_{10}$' in the index shows that the evidence is calculated by dividing the probability of the alternative hypothesis ('1') by that of the null hypothesis ('0'), hence 100/1=100. Additionally, if one can appropriately define prior expectations about different hypotheses, the posterior odds can be specified. These odds, like *BF*s, are ratios, calculated by multiplying the *BF* with the hypothesis's prior probability.[32] For reporting Bayesian estimation, we adhered to the guidelines published by the American Psychological Association.[33]

Sensitivity analysis

For sensitivity analysis, we used Jeffreys-Zellner-Siow as a prior and performed both a Bayesian and classical analysis of covariance to assess for between-group differences at T2 and T3 with the insomnia score at baseline as a covariate and also performed these analyses with the study-completer sample. For all analyses, ANCOVAs were performed with baseline scores as a covariate to control for potential baseline imbalances. All reported p values are two-sided with a significance level of 0.05. For both Bayesian and classical statistics, data analysis was performed using JASP V.0.14.1.0. We addressed missing data using multiple imputations, generating 10 estimates for each missing value.

Table 2 Means and SD of outcome variables at baseline post-treatment (8 weeks)

	T1				T2			
	Recovery		Waitlist		Recovery		Waitlist	
Outcome	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Insomnia severity	18.51	3.04	18.15	2.40	9.48	4.35	15.59	3.69
Depression	23.33	8.22	23.44	7.70	15.02	8.61	21.64	7.84
Recuperation in sleep	2.25	0.68	2.24	0.46	3.14	0.71	2.28	0.52
Work-related rumination	18.10	1.86	17.83	2.50	13.51	3.73	17.50	2.31
Worrying	10.32	4.64	10.70	3.54	6.58	3.94	9.28	4.22
Detachment	2.03	0.62	1.85	0.53	2.86	0.71	2.08	0.67
Recreational activities	45.97	11.02	46.86	10.93	55.62	12.73	49.31	11.69
Segmentation supplies	2.43	1.03	2.63	1.08	2.95	1.47	2.66	1.33
Negative Home-Work-Interference	6.75	2.37	6.61	2.06	6.00	1.92	6.45	1.80
Negative Work-Home-Interference	17.69	4.14	20.12	3.92	18.25	3.26	20.09	2.49
Positive Home-Work Interference	12.55	2.85	11.19	2.39	13.25	3.02	11.92	2.28
Positive Work-Home Interference	10.34	2.49	10.76	2.83	11.22	3.18	11.22	3.18

Table 3 Model comparisons for the Bayesian analysis of covariance with informed and uninformed prior at T1 and T2

Models	Model content	P(M)	Informed prior			Uninformed prior		
			P(M|data)	BF_{10}	BF_{01}	P(M|data)	BF_{10}	BF_{01}
Null model	No difference between groups	0.25	<0.001	1.00	1.00	<0.001	1.00	1.00
Insomnia baseline	Null model+main effect of insomnia baseline	0.25	<0.001	$3.66\times e^{12}$	<0.001	<0.001	4.50	0.22
Condition model	Null model+main effect of condition	0.25	<0.001	$2.02\times e^{39}$	<0.001	<0.001	$1.65\times e^{11}$	<0.001
Condition+baseline	Null model+condition + insomnia baseline	0.25	0.99	$3.23\times e^{60}$	<0.001	0.99	$3.80\times e^{13}$	<0.001

FINDINGS

Participants

The flow of participants is depicted in figure 1. Of the 404 individuals who expressed interest in participating, 201 were assessed for eligibility. Of these, 128 met the inclusion criteria and were randomised to either the intervention (n=64) or control group (n=64).

Baseline characteristics

Table 1 summarises the baseline characteristics of the study participants. As recommended in the CONSORT statement,[34] we refrained from testing for statistical baseline differences between the groups. A close examination of all baseline characteristics revealed no evidence of practically meaningful differences between the groups. In the intervention group, 51 out of 64 participants (80%) completed all six modules and only 8% requested feedback from the psychological e-coach.

Primary outcome

Table 2 shows the means and *SD* for all outcome measures at baseline (T1), and post-treatment (T2). Relative to WLC, the intervention group reported reduced insomnia symptoms with a large effect size (Cohen's $d=1.51$; 95% CI=1.12 to 1.91), with a difference in the ISI score of 6.12 points at T2 (online supplemental figure S1).

For Bayesian analysis, ANCOVA was performed on the main effect of the intervention with the ISI score as a covariate using data extracted from three previously-reported studies. For the main analysis, we compared four different models which are summarised in table 3. The ANCOVA model, including both intervention group and baseline score as variables, exhibited the best model fit and highest Bayesian factor, with a BF_{10} of $3.23\times e^{60}$ and probability of greater than 99.99%, indicating extremely strong evidence in favour of the alternative over null hypothesis.[35] This assumes the superiority of the intervention, thereby providing the strongest support for the model which included the covariate and group variable. Sensitivity analysis with Jeffreys-Zellner-Siow as a prior yielded a similar result, as did classical ANCOVA, implying that the differences in insomnia between the two study groups are highly unlikely to be explained by chance ($F=86.94$, $p<0.001$). Similar results could be shown by performing the analyses with only the study-completers (BF_{10} of $1.09\times e^{10}$ and 98% probability; frequentist analysis: $F=62.21$, $p<0.001$)).

Results at 6-month follow-up were similar to those at T2, showing a large effect size ($d=1.63$; 95% CI=1.23 to 2.03) and a difference in ISI score versus T1 of 6.24 points. The Bayesian ANCOVA model with an informed prior exhibited the best model fit and highest Bayesian factors ($BF_{10}=1.27\times e^{70}$ and probability=99.99%, see online supplemental table S3). These results also were supported by classical frequentist ANCOVA ($F=26.20$, $p<0.001$) and by the analysis of the study-completers.

A detailed table of symptom-free status and meaningful improvement for insomnia and depression with respective NNTs and symptomatic deterioration is available in online supplemental table S4.

Secondary outcomes

For the secondary outcomes, positive impacts for subjects in the intervention versus WLC group were detected at T2 and T3 for recuperation in sleep ($d=1.40$), depression ($d=0.73$), work-related rumination ($d=0.29$), worrying ($d=0.69$), detachment ($d=1.10$) and recreational activities ($d=0.52$). For most outcome measures, Bayesian statistics resulted in probabilities of roughly 99%, for the respective ANCOVA models, indicating that the differences between groups can be best explained by the model containing the variables baseline score and group. Concerning negative Work-Home-Interference, Bayesian analysis indicated that the difference ($d=0.55$) can be best explained by the ANCOVA model with a probability of 77%. The ANCOVA probabilities of negative Home-Work-Interference were 48%, for positive 27%, and for positive Work-Home-Interference 24% for the respective ANCOVA models. Concerning segmentation supplies, Bayesian ANCOVA estimated a probability of 21%. Sensitivity frequentist analysis revealed significant between-group differences for depression, recuperation in sleep, work-related rumination, worrying, detachment and recreational activities. Pertaining to working conditions, no significant inter-group differences were detected in segmentation supplies, positive or negative Home-Work-Interference, as well as positive and negative Work-Home-Interference.

CONCLUSIONS

The current study evaluated the effectiveness of an internet-based CBT training programme for employees in the general working population with sleep problems, exposed to blurred boundaries between work and non-work. Results suggest that the intervention was effective in reducing insomnia severity in the intervention group, relative to waiting list controls, short-term and long-term. Results were shown by both Bayesian and frequentist analyses with large effect sizes ($d=1.51$). Given that segmentation supplies remained stable throughout the intervention, we conclude that the intervention was successful at fostering employees' skills in reducing work-related rumination and increasing mental detachment, even in adverse working conditions.

In general, our findings are consistent with results examining the effect of CBT-I on sleep. A meta-analysis identified average differences of 4.29[15] in favour of CBT-I post-intervention, compared with 6.12 points in the present study, making the latter slightly greater. The NNT in our study, at just 1.60, is even less than in the results of a meta-analysis reported by Cheng and Dizon,[17] in which the average NNT across the primary studies was 3.59. We observed a larger effect on work-related rumination (d=1.29) and detachment (d=1.10) than in Karabinski's meta-analysis,[14] in which an intervention effect of d=0.36 was reported for detachment defined as the absence of negative work-related thinking. The larger effects we observed might be explained by the present online intervention, featuring several exercises aimed specifically at helping individuals cope with blurred boundaries and foster detachment. Detachment and work-related rumination could thus be potential mediators in terms of sleep, aligning with the assumptions of the hyperarousal model of insomnia.[11]

The overall strong effects of GET.ON Recovery on insomnia, work-related rumination and mental detachment are noteworthy, especially given that the assumed underlying organisational risk factor—low segmentation supplies—remained largely unchanged. On one hand, this offers a hopeful perspective for workers affected by low segmentation supplies, as improvement is achievable even without changes in contextual factors. Nixon *et al*[36] observed a similar result, with perceived stress decreasing substantially following an online stress-management intervention, despite persistent workplace stressors. On the other hand, symptoms of insomnia on average remained elevated at a subclinical level, potentially reflecting the ongoing negative impact of adverse working conditions on employees. Therefore, individually-focused interventions may therefore have a 'glass floor', unable to reduce symptoms to normal levels unless complemented by organisation-based interventions.

From a methodological perspective, this study, to the best of our knowledge, was the first to apply and compare Bayesian with the widely-used frequentist evaluation method in the field of sleep and occupational health. Using evidence-based prior from previous studies is a major advantage of the present study, addressing the common critique of employing weak priors.[31] Regarding insomnia severity, we found that the posterior model odds are about 99.99%, indicating that the intervention is 99.99% certain to be superior to the control. This straightforward expression demonstrates a communicative advantage of Bayesian statistics: its direct and positive manner of presenting results, which seems easier for less statistics-savvy individuals to comprehend than reporting the rejection of a null hypothesis, stating that there is no difference using one-minus-probability expressions like $p<0.001$. For most secondary outcomes, we detected large *BF*s with high probabilities and very low p values via the frequentist approach, both of these providing empirical support for the intervention's positive effects on mental health. Particularly interesting are findings where the Bayesian and frequentist approaches yield different conclusions: Since the frequentist approach adheres to a binary principle (significant or non-significant) that is specified by conventions (eg, $p<0.05$), a non-significant result is likely to lead to a rejection of the implementation of an intervention, disregarding contextual factors. For instance, in assessing positive and negative Home-Work- and Work-Home-Interference, no statistically-significant effects ($p>0.05$) were detected, leading to the conclusion that the intervention does not significantly improve these characteristics. From a Bayesian perspective, we observed a 77% probability that the intervention helps prevent negative spillover from work to home. Occupational health practitioners might inform employees who are seeking to reduce negative spillover effects about the 77% probability of a beneficial effect while discussing necessary costs, such as time or financial investment, required to take up the intervention. In a shared decision-making process, considering both the individual importance of the outcome and available alternatives, the help-seeker can draw their own conclusions and decide whether to uptake the intervention or not. Therefore, the results illustrate how the Bayesian perspective has the potential to empower people to make informed decisions by understanding the probability of benefits and considering the costs. Following recommendations proposed by Wijeysundera *et al*,[37] the present study might serve as a blueprint for future trials in occupational health as a way to report both frequentist results and Bayesian posterior probabilities in RCTs.

Several limitations should be considered: First, segmentation preferences were not assessed in our sample, and such preferences sometimes serve as a moderator between segmentation supplies and health-related outcomes.[38] Therefore, the fit of preferences and supplies should be assessed in further research. Second, the long-term effects should be interpreted with caution, as we had a relatively high loss to follow-up of 44% at 6 months. Third, the results may not be generalisable to the implementation of the intervention as part of a company's occupational health management. The provision of occupational e-mental health interventions by companies (workplace recruitment) appears to be associated with smaller effects than recruitment strategies that directly approach employees (community recruitment), as was the case in the present study. Lastly, no firm conclusions about the incremental effect of exercises promoting detachment and coping with low segmentation supplies can be drawn. Using a generic i-CBT-I intervention as a comparator in future studies would be informative.

Clinical implications

This study found that recovery training was effective in reducing insomnia symptoms and improving a variety of other health-related outcomes, including symptoms of depression, work-related rumination and mental detachment from work. These results could be particularly crucial to maintaining long-term health in employees facing adverse working conditions with blurred boundaries. Future studies will identify the acceptance, uptake and efficacy of these combined work and worker-directed mental health interventions.

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Contributors HH, DL and DDE developed the intervention and conducted the study. HB, SW and DL conducted the statistical analysis. HB wrote the first draft of the manuscript under the supervision of DL. HB and DL are guarantors.

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Competing interests HH and DDE are stakeholders of the 'Institute for Online Health Trainings', a company that aims to transfer scientific knowledge, including the present intervention, into routine occupational health care. HB, SW and DL have reported no conflicts of interest.

Patient consent for publication Not applicable.

Ethics approval The study involves human participants and was approved by the Ethics committee of Leuphana University. The ID is: EB-Antrag_Lehr201403_Schlaftraining. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available upon reasonable request. Individual participant data underlying the results reported in this article will be made available, after de-identification, to researchers who submit a methodologically sound proposal.

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