Effectiveness of an internet-based intervention to improve sleep difficulties in a culturally diverse sample of international students

Spanhel, Kerstin; Burdach, Daniela; Pfeiffer, Teresa; Lehr, Dirk; Spiegelhalder, Kai; Ebert, David D.; Baumeister, Harald; Bengel, Juergen; Sander, Lasse B.

Published in:
Journal of Sleep Research

DOI:
10.1111/jsr.13493

Publication date:
2022

Document Version
Publisher's PDF, also known as Version of record

Received: 1 December 2020 | Revised: 7 September 2021 | Accepted: 7 September 2021

DOI: 10.1111/jsr.13493

Journal of Sleep Research

RESEARCH ARTICLE

Effectiveness of an internet-based intervention to improve sleep difficulties in a culturally diverse sample of international students: A randomised controlled pilot study

Kerstin Spanhel[1] | Daniela Burdach[1] | Teresa Pfeiffer[1] | Dirk Lehr[2] | Kai Spiegelhalder[3] | David D. Ebert[4] | Harald Baumeister[5] | Juergen Bengel[1] | Lasse B. Sander[1]

[1]Department of Rehabilitation Psychology and Psychotherapy, Institute of Psychology, University of Freiburg, Freiburg, Germany

[2]Department of Health Psychology, Institute of Psychology, Leuphana University Lueneburg, Lueneburg, Germany

[3]Department of Psychiatry and Psychotherapy, Medical Center – University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany

[4]Psychology und Digital Mental Health Care, Department of Sport and Health Sciences, Technical University of Munich, Munich, Germany

[5]Department of Clinical Psychology and Psychotherapy, Institute of Psychology and Education, Ulm University, Ulm, Germany

Correspondence
Kerstin Spanhel, Department of Rehabilitation Psychology and Psychotherapy, Institute of Psychology, University of Freiburg, Engelbergerstr. 41, D-79085 Freiburg, Germany.
Email: kerstin.spanhel@psychologie.uni-freiburg.de

Funding information
German Academic Scholarship Foundation

Summary

Sleep difficulties are widespread among international students. Internet-based interventions are suggested as a low-threshold treatment option but may require cultural adaptation among culturally diverse populations. The present pilot study investigated the effectiveness and acceptance of an internet-based intervention to improve sleep difficulties in international students. A total of 81 international students of 36 nationalities were randomly assigned to the intervention (n = 41) or waitlist control group (n = 40). The intervention group received immediate access to a culturally non-adapted unguided internet-based sleep intervention consisting of three modules based on sleep hygiene and cognitive techniques to reduce rumination. At baseline, 4 and 12 weeks after randomisation, insomnia severity, measured by the Insomnia Severity Index, and secondary outcomes (sleep quality, depression, anxiety, perceived stress, well-being, presenteeism, mental health literacy) were assessed. Data were analysed using linear multi-level analyses. Additionally, satisfaction and perceived cultural appropriateness of the intervention were evaluated by international students after 4 weeks, and compared with ratings of German students, who represent the original target group. Insomnia severity improved over time in the intervention group compared to the control group, revealing a significant estimated mean difference of −5.60 (Hedges' g = 0.84, $p < 0.001$) after 12 weeks. Satisfaction and perceived cultural appropriateness was high and comparable to that of German students. The present study shows that a culturally non-adapted internet-based sleep intervention can be a low-threshold treatment option to help meet the high demand for mental healthcare among international students. It thus indicates that cultural adaptation might not represent a precondition for providing effective internet-based sleep interventions to this target group.

KEYWORDS
culturally sensitive treatment, eHealth, insomnia, mental health treatment gap

1 | INTRODUCTION

Sleep onset and maintenance difficulties are highly prevalent among college students (Jiang et al., 2015). This might be caused by a high number of stressors, including separation from home or pressure of good academic performance (Ribeiro et al., 2018). Mental health problems associated with sleep difficulties are shown to be widespread among college students (Auerbach et al., 2016). Considering the positive effect of sleep-related interventions (Ashworth et al., 2015; Colvonen et al., 2018) and preventions (Chan et al., 2021) on associated mental disorders, this highlights the importance of sleep-related interventions in this target group. A recent meta-analysis showed that psychological interventions can effectively improve sleep and daytime functioning among college students (Saruhanjan et al., 2020). Yet, it remains unknown whether psychological sleep interventions are also effective in the specific group of international, i.e. culturally diverse, college students. International as compared to domestic college students might be exposed to additional stressors, such as discrimination and lack of social support (Smith & Khawaja, 2011). Correspondingly, sleep difficulties and other mental health problems are shown to be highly prevalent among them (Pusztai, Rozmann, Horváth, Szunomár, & Fusz, 2019). However, international college students rarely use mental health services (Skromanis et al., 2018). This may be due to low mental health literacy (Hyun, Quinn, Madon, & Lustig, 2007), i.e. limited knowledge about mental disorders and their treatment in the foreign country, and other barriers revealed among college students (Ebert et al., 2019) and culturally diverse people (Scheppers, van Dongen, Dekker, Geertzen, & Dekker, 2006), such as fear of stigmatisation and language barriers.

As part of the World Health Organisation (WHO) World Mental Health International College Student initiative (Cuijpers et al., 2019), internet-based interventions as low-threshold treatments are suggested to help overcome such barriers among college students (Ryan, Shochet, & Stallman, 2010), and to be a viable solution as prevention or early intervention (Buntrock et al., 2016; Sander, Rausch, & Baumeister, 2016). In fact, internet-based interventions seem to effectively improve sleep difficulties among college students, comparable to face-to-face psychological interventions (Saruhanjan et al., 2020). Yet, studies investigating the efficacy of internet-based sleep interventions for international college students are lacking, contrasting a well-demonstrated efficacy of such interventions in clinical samples (Zachariae, Lyby, Ritterband, & O'Toole, 2016). A simple solution to provide low-threshold treatment to this group would be to use (translated versions of) interventions developed for domestic college students also for international college students. There are findings that interventions specifically developed for international college students reduced their stigmatising attitudes (Clough, Nazareth, & Casey, 2020) and improved mental health (Kanekar, Sharma, & Atri, 2010), and that internet-based interventions culturally adapted for students in Indonesia (Rahmadiana et al., 2021) and Colombia (Salamanca-Sanabria et al., 2020) reduced their depressive and anxiety symptoms. However, there is a lack of evidence on the effectiveness of culturally non-adapted interventions in target groups differing from the original populations. Findings from a meta-analysis on culturally adapted internet-based interventions for non-student groups indicate that cultural adaptation enhances the efficacy of such interventions in culturally differing target groups, which may suggest that it is a precondition for the effectiveness of internet-based interventions (Harper Shehadeh, Heim, Chowdhary, Maercker, & Albanese, 2016).

Muñoz et al. (2018) recommend examining the efficacy and acceptance of an existing internet-based intervention among a new target group prior to its cultural adaptation. Following this recommendation, we conducted a two-armed randomised controlled pilot trial in international college students, comparing an intervention group (IG) with access to a culturally non-adapted brief internet-based intervention to improve sleep difficulties (StudiCare Sleep-e) to a waitlist control group (CG). The intervention was based on the intervention GET.ON Recovery, which was originally developed for and evaluated among German teachers and employees, revealing large effect sizes of d = 1.37 (95% confidence interval [CI] 0.99 to 1.77; Ebert et al., 2015) and d = 1.45 (95% CI 1.06 to 1.84; Thiart, Lehr, Ebert, Berking, & Riper, 2015). We aimed to investigate whether the intervention effectively improved insomnia severity, sleep quality, and other mental health issues among international students over a period of 12 weeks. Moreover, we aimed to examine whether international students were satisfied with the intervention and perceived it as culturally appropriate, also in comparison with additional data collected from German students, who the intervention originally targeted.

2 | METHODS

2.1 | Study design, participants, and procedure

The present pilot study was conducted within the framework of StudiCare (e.g., Harrer, Adam, Fleischmann, et al., 2018; Kählke et al., 2019), a project that is part of the WHO World Mental Health International College Student initiative, which aims to develop and implement a system to improve prevention and early interventions for mental health problems among college students (Cuijpers et al., 2019). The study was registered in the German Clinical Trials Register (identifier: DRKS00018854). Deviations from the registration protocol are listed in the Supporting Information A. The commissioner for data protection and the Local Ethics Committee at the University of Freiburg approved the study (no. 267/19). We followed the Consolidated Standards of Reporting Trials (CONSORT) guidelines (http://www.consort-statement.org/).

The entire study was conducted online. Recruitment took place across various German-speaking Universities from August 2019 to February 2020, with the last follow-up assessment being completed in May 2020. Information on the study was distributed via social media platforms, mailing lists of various universities (e.g. international offices), and flyer distribution at the University of Freiburg, Germany. All recruitment channels referred to the StudiCare

website (https://www.studicare.com/), where potential participants could declare their interest in participating by registration. Interested participants were mailed a link to detailed study information and the informed consent form, which they could sign online. Subsequently, they were mailed a link to the baseline assessment, in which the inclusion criteria for study participation were assessed at the beginning. Inclusion criteria were set low and did not include a minimum degree of sleep difficulties in order to get information on who might be interested in using such an intervention irrespective of fulfilling clinical criteria for sleep disorders. Furthermore, including persons with subclinical symptoms is consistent with the WHO World Mental Health International College Student initiative's aim of providing prevention and early interventions for mental health problems among students (Cuijpers et al., 2019), which at the same time represents a naturalistic setting for the potential implementation of internet-based interventions in healthcare. Inclusion criteria were: (1) age ≥18 years, (2) sufficient English language skills, (3) international student status at a German-speaking university, and (4) provided informed consent. After completion of the baseline assessment, eligible participants were randomised 1:1 to either the IG or CG by an independent researcher of the methods centre of the Rehabilitation Research Network Freiburg who was not further involved in the study. The researcher used an automatic randomisation software (https://www.sealedenvelope.com/), applying permuted block randomisation with randomly varying block sizes of two and four. All participants were mailed again and informed on the further study process: the IG got immediate access to the intervention after randomisation, the waitlist CG got access after the completion of the final assessment. Participants had the chance to win a 50-Euros Amazon voucher after completing the final assessment.

2.2 | Intervention

StudiCare Sleep-e is an English unguided brief internet-based intervention to improve sleep difficulties based on cognitive behavioural therapy (CBT). It was adapted from GET.ON Recovery, an evaluated internet-based intervention for German teachers with sleep difficulties (Thiart et al., 2015). Adaptation included content (e.g. removal of sleep restriction), duration (shortened from six to three modules), language (translation into English), and the use of students as case examples. No changes regarding cultural aspects were made. The intervention was provided on the Minddistrict platform (https://www.minddistrict.com/) and consists of three modules, each of which can be completed in ~30 min. After completing a module, the next module was activated; participants were recommended to complete one module per week. Reminders were sent via the platform if participants did not progress with the intervention for more than a week. The intervention could hence be completed in about 3 weeks. Contents included easy to implement psychoeducation on sleep difficulties, rumination, and associated mental health issues; sleep hygiene rules; cognitive exercises to deal with rumination; and links to further mental healthcare options, so as to facilitate the access to the health system (see Supporting Information B; Table S1). Exercises during and between the modules (e.g. the realisation of chosen sleep hygiene rules) should enable the implementation in everyday life. Simply clicking through a module without completing the exercises was hindered by the requirement of the platform to complete the text fields in order to submit the module. However, due to the unguided character of the intervention, the realisation of the exercises was not reviewed in detail.

2.3 | Outcomes

Outcomes were assessed by online self-report at baseline (T1) and 4 (T2) and 12 weeks (T3) after randomisation. In addition to the outcome measures listed below, we assessed sociodemographic variables and previous psychiatric and psychotherapeutic treatments at T1, as well as current treatments at T2 and T3.

2.4 | Effectiveness of the intervention

2.4.1 | Primary outcome

The primary outcome was insomnia severity, assessed with the Insomnia Severity Index (ISI; Bastien, Valliéres, & Morin, 2001). The ISI includes seven items on a 5-point Likert scale (0–4). It yields a global score ranging from 0 to 28, with a higher score indicating higher insomnia severity. It has an acceptable internal consistency (Cronbach's $\alpha = 0.74$ [Bastien et al., 2001]; in the present study, Cronbach's α was 0.84).

2.4.2 | Secondary outcomes

Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI [Buysse, Reynolds, Monk, Berman, & Kupfer, 1989]; 19 items representing seven components; scale 0–3; range 0–21 with a higher score indicating poorer sleep quality; good $\alpha = 0.83$ [Buysse et al., 1989], questionable $\alpha = 0.68$ in present study). In addition, mental health outcomes associated with sleep disturbances were assessed (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006). Depressive symptoms were assessed with the Patient Health Questionnaire (PHQ-8 [Kroenke et al., 2009]; eight items; scale 0–3; range 0–24 with a higher score indicating increased depressive symptoms; good $\alpha = 0.82$ in previous studies [Pressler et al., 2011], $\alpha = 0.87$ in present study). Anxiety symptoms were assessed with the Generalised Anxiety Disorder Scale (GAD-7 [Spitzer, Kroenke, Williams, & Löwe, 2006]; seven items; scale 0–3; range 0–21 with a higher score indicating increased anxiety symptoms; excellent $\alpha = 0.92$ [Spitzer et al., 2006], good $\alpha = 0.88$ in present study). Perceived stress was assessed with the Perceived Stress Scale (PSS-4 [Cohen, Kamarck, & Mermelstein, 1983]; four items; scale 0–4; range 0–16 with a higher score indicating

increased perceived stress; acceptable α = 0.77 in previous studies [Warttig, Forshaw, South, & White, 2013], good α = 0.81 in present study). General well-being was assessed with the WHO-5 Well-Being Index (Bech, Olsen, Kjoller, & Rasmussen, 2001; five items; scale 0–5; range 0%–100% with a higher percentage indicating increased well-being; good α = 0.84 [Bech et al., 2001], α = 0.85 in present study). Presenteeism was assessed with the Presenteeism Scale for Students (PSfS [Matsushita et al., 2011]). The PSfS yields three scores: the Work Impairment Score (WI; 10 items; scale 0–4; range 0–100 with a higher score indicating increased presenteeism; excellent α = 0.90 [Matsushita et al., 2011], unacceptable α = 0.12 in present study); the Work Output Score (WO; single item, range 0%–100% with a higher percentage indicating a higher productivity level; retest reliability R_{tt} = 0.77 [Matsushita et al., 2011]); the Hours of Absenteeism Score (HA; single item, 0 to >40 hr of absence during the past month; R_{tt} = 0.78 [Matsushita et al., 2011]). Mental health literacy was assessed with the Mental Health Literacy Questionnaire in Young Adults (MHLQ [Dias, Campos, Almeida, & Palha, 2018]; 29 items; scale 1–5; range 29–145 with a higher score indicating higher mental health literacy; good α = 0.84 [Dias et al., 2018], α = 0.83 in present study). This questionnaire assesses literacy among four dimensions: knowledge on mental health problems, stereotypes, first aid skills, and self-help strategies.

2.5 | Acceptance of the intervention

Satisfaction with and perceived cultural appropriateness of the intervention among participants in the IG were assessed at T2. Participants' satisfaction was assessed with the Client Satisfaction Questionnaire adapted for Internet Interventions (CSQ-I [Boß et al., 2016]; eight items; scale 1–4; range 8–32 with a higher score indicating greater client satisfaction; excellent McDonald's omega = 0.95 [Boß et al., 2016], α = 0.96 in present study). Cultural appropriateness of the intervention was evaluated with the self-developed Cultural Appropriateness Questionnaire (CAQ; 38 items resulting in the subscales: structure, five items; design, 10 items; language, eight items; content, 15 items; scale 1–5; score 38–190 with a higher score indicating a higher level of perceived cultural appropriateness; good α = 0.88 in present study). Considering missing population norms for both CSQ-I and CAQ, we additionally surveyed a German student sample that completed only these questionnaires after going through the intervention, herewith providing a base for evaluating the extent of satisfaction and perceived cultural appropriateness among the international students.

2.6 | Adherence to the intervention

Adherence to the intervention was described by the mean (*SD*) of completed modules among participants in the IG, as well as the rates of non-starters and completers.

2.7 | Negative effects of the intervention

Potential side-effects of the internet-based intervention were assessed at T2 among participants in the IG, using the Inventory for the Assessment of Negative Effects of Psychotherapy (INEP [Ladwig, Rief, & Nestoriuc, 2014]), adapted for internet-based interventions, with two parts: (a) assessment of potential changes that might have occurred due to the internet-based intervention (e.g. in well-being, relationships, stigmatisation: six items, scale −1 [negative effect]; 0 [unchanged]; 1 [positive effect]; eight items, scale 0 [disagree] to 3 [fully agree]); (b) assessment of specific harms caused by the internet-based intervention (e.g. hurtful content: five items, scale 0 [disagree] to 3 [fully agree]). Good α = 0.86 [Ladwig et al., 2014], unacceptable α = 0.47 in present study. Information on negative effects of the training were considered individually, no scores were calculated.

2.8 | Statistical analyses

Analyses were processed using the IBM® SPSS® Statistics version 27, conducted according to the intention-to-treat principle, and based on a two-sided alpha level of 5%. The intervention effects for the primary and secondary outcomes at the follow-up assessments T2 and T3 were determined by means of multi-level analyses, with time (T1, T2, T3) on level 1 and individual subjects on level 2 (random intercept, fixed slope; diagonal variance structure). Missing values were implicitly estimated in the multi-level analyses. Outcomes at T1, T2, and T3 were modelled with a linear model, including group and time; the group × time interaction tested differences in the outcomes between the groups. Post hoc pairwise group comparisons were conducted at the respective time points in case of a significant group × time interaction. We calculated standardised between-group effect sizes (Hedges' *g*; Hedges & Olkin, 1985) by dividing the model-based estimated group mean differences by the corrected pooled *SD*.

The satisfaction with and cultural appropriateness of the intervention perceived by the IG were compared to the ratings of the German comparison sample using one-sided *t* tests, assuming a lower perceived satisfaction and cultural appropriateness for the international students.

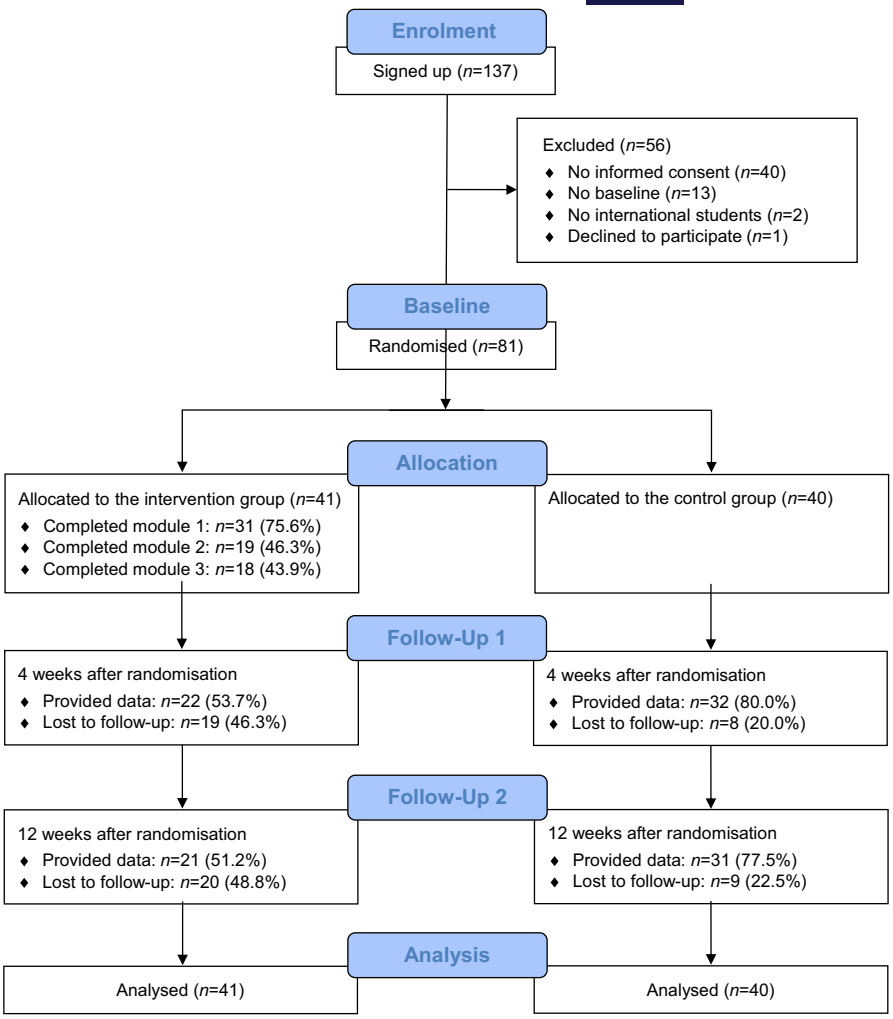
Results regarding the adherence to the intervention, as well as negative effects of the intervention, are presented descriptively.

3 | RESULTS

3.1 | Participants

A total of 81 participants were randomised to the IG (*n* = 41) and CG (*n* = 40). Participants' flow of the pilot study and their sociodemographic details can be found in Figure 1 and Table 1. In all, 40 participants were female, 40 were male, and one participant identified as non-binary. The mean (*SD*; range) age was 26.8 (4.4; 20–42) years. The participants came from 36 nationalities (most frequently "India"; *n* = 12) and studied at 19 different universities (most frequently

FIGURE 1 Study flow chart



"University of Freiburg"; $n = 32$). In all, 39 of them had never sought psychological treatment before, seven were in current psychotherapeutic treatment. Six participants showed no clinical insomnia, 23 subthreshold insomnia, and 52 clinical insomnia. Sociodemographic data (Table 1) and baseline characteristics of the outcome data (Tables 2 and 3) were comparable in the IG and CG, and no differences were observed between participants who completed the follow-up assessments and those who did not, neither between participants who completed or started the intervention and those who did not.

The German comparison sample for investigating intervention acceptance comprised 30 participants (24 female), with a mean (*SD*) age of 22.0 (1.9) years. Details on the characteristics of the German student sample can be found in the Supporting Information B; Table S2.

3.2 | Effectiveness of the intervention

3.2.1 | Primary outcome

At baseline, the observed mean (*SD*) ISI score was 15.2 (5.9) in the IG and 16.6 (5.4) in the CG. After 4 weeks, a mean (*SD*) of 10.1 (5.3) was observed in the IG and 13.4 (4.8) in the CG, with an estimated mean difference of −2.4 (95% CI −4.9 to 0.1, $p = 0.063$). The estimated mean difference was significant with −5.6 (95% CI −8.5 to −2.7, $p < 0.001$) and an effect size of $g = 0.84$ after 12 weeks, with a mean (*SD*) of 7.4 (4.9) observed in the IG and 13.5 (5.9) in the CG (Table 2 and Figure 2).

3.2.2 | Secondary outcomes

Table 3 shows the results of the multi-level analyses for the secondary outcomes. The multi-level analyses revealed significant group × time interaction effects for the PSQI, with significant estimated mean differences at T2 and T3; for the PHQ-8, with a significant estimated mean difference at T3; for the PSS-4, not yielding any significant estimated mean differences at T2 or T3; for the WHO-5, with a significant mean difference at T2. All significant estimated mean differences were in favour of the IG and revealed moderate effect sizes. No significant interaction effects were found for the GAD-7, the three scales of the PSfS, or the MHLQ.

TABLE 1 Characteristics of all participants, assessed at baseline

Characteristic	All participants ($n = 81$)	IG ($n = 41$)	CG ($n = 40$)
Age, years, mean (*SD*)	26.8 (4.4)	25.8 (3.8)	27.9 (4.7)
Gender, female, *n* (%)	40 (49.4)	21 (51.2)	19 (47.5)
In a relationship, married, *n* (%)	16 (19.7)	9 (22.0)	7 (17.5)
Months in Germany, mean (*SD*)	25.6 (23.2)	24.1 (25.1)	27.1 (21.2)
English language skills, *n* (%)			
Intermediate, Upper-intermediate	10 (12.3)	6 (14.6)	4 (10.0)
Pre-advanced, advanced	71 (87.7)	35 (85.4)	36 (90.0)
Purpose of stay, *n* (%)			
Bachelor studies	10 (12.3)	6 (14.6)	5 (10.0)
Master studies	41 (50.6)	22 (53.7)	19 (47.5)
PhD studies	19 (23.5)	7 (17.1)	12 (30.0)
Exchange programme	10 (12.3)	5 (12.2)	5 (12.5)
State examination	1 (1.2)	1 (2.4)	0
Previous use of psychological help, *n* (%)			
No	39 (48.1)	21 (51.2)	18 (45.0)
Internet/counselling centre	35 (43.2)	21 (51.2)	14 (35.0)
Doctor/psychotherapist	26 (32.1)	9 (22.0)	17 (42.5)
Insomnia Severity[a], *n* (%)			
Not clinical	6 (7.4)	3 (7.3)	3 (7.5)
Subthreshold	23 (28.4)	14 (34.1)	9 (22.5)
Clinical – moderate	40 (49.4)	17 (41.5)	23 (57.5)
Clinical – severe	12 (14.8)	7 (17.1)	5 (12.5)
Current use of psychological help, *n* (%)			
At the 4-week follow-up	10 (17.2), $n = 58$	2 (8.3), $n = 24$	8 (23.5), $n = 34$
At the 12-week follow-up	10 (18.9), $n = 53$	4 (19.0), $n = 21$	6 (18.8), $n = 32$
	All participants ($n = 81$)		
Nationality (*n*)	India (12), Colombia (7), Mexico (7), Taiwan (5), USA (5), Germany (4), Syria (4), China (3), Iran (3), Poland (3), Egypt (2), Pakistan (2), Azerbaijan (1), Brazil (1), Great Britain (1), Burundi (1), Cameroon (1), Canada (1), Chile (1), Croatia (1), Ecuador (1), Israel (1), Italy +Great Britain (1), Mongolia (1), Morocco (1), Nepal (1), Palestine (1), Romania (1), Russia (1), Singapore (1), Slovenia (1), Spain (1), Sri Lanka (1), Ukraine (1), USA +Mexico (1), Yemen (1)		
Study field (*n*)	Computer science and engineering (19), natural sciences (16), social sciences (14), environment (12), business and economics (9), medicine (5), humanities (2), law (2)		

Abbreviations: CG, control group; IG, intervention group; *SD*, standard deviation.

[a]Based on Insomnia Severity Index total score categories (Bastien et al., 2001): 0–7 = no clinically significant insomnia, 8–14 = subthreshold insomnia, 15–21 = clinical insomnia (moderate), 22–28 = clinical insomnia (severe).

3.3 | Acceptance of the intervention

Satisfaction with the intervention was high: the CSQ-I yielded a mean (SD) score of 24.6 (6.1) among the international students in the IG who completed T2 ($n = 22$). Details on the CSQ-I ratings of the IG can be found in the Supporting Information B; Table S3. The ratings did not significantly differ from the mean (*SD*) score of 26.1 (4.5) in the German student sample ($n = 30$), $t(50) = 0.97$, $p = 0.338$. Similarly, the cultural appropriateness of the internet-based intervention was rated high among the international students: the global score of the CAQ (mean [*SD*] 151.0 [12.6]) was not significantly lower than the score of the German sample (mean [*SD*] 128.8 [20.3]). Neither were any of the subscales rated lower by the international students than by the German students. In contrast to the assumptions, German students perceived the internet-based intervention as less culturally appropriate. Details on the ratings of the international students and the German sample can be found in the Supporting Information B; Table S4.

TABLE 2 Results for the primary outcome measured by the Insomnia Severity Index (Bastien et al., 2001)

	IG		CG		Adjusted effect estimates			
	N	Observed, mean (*SD*)	*N*	Observed, mean (*SD*)	Mean difference (95% CI)	*p*	Hedges' g (95% CI)	Interaction test (time × group)
T1	41	15.2 (5.9)	40	16.6 (5.4)				$F_{2,59} = 4.98$, $p = 0.010$
T2	22	10.1 (5.3)	32	13.4 (4.8)	−2.4 (−4.9 to 0.1)	0.063	0.42 (−0.02 to 0.86)	
T3	21	7.4 (4.9)	31	13.5 (5.9)	−5.6 (−8.5 to −2.7)	<0.001	0.84 (0.39 to 1.30)	

CG, control group; CI, confidence interval; IG, intervention group; *SD*, standard deviation; T1, Baseline assessment; T2, 4-week follow-up assessment; T3, 12-week follow-up assessment.

3.4 | Adherence to the intervention

The participants in the IG completed a mean (*SD*) of 1.7 (1.3) modules, which equals 55.3% of the internet-based intervention. A total of 10 participants (24.4%) did not start the internet-based intervention; with exception of one participant who completed the second module, all starters finished the whole intervention ($n = 18$ [43.9%]; Figure 1). Post hoc analyses, comparing the intervention effect on the primary outcome at T3 between participants who started ($n = 31$) or completed ($n = 18$) the intervention and those who did not start ($n = 10$) or complete ($n = 23$), revealed significant differences only between IG starters and CG with g = 0.89, as well as between IG completers and CG with g = 1.09, but not between the IG non-starters or IG non-completers and CG, with g = 0.60 and g = 0.49, respectively. Detailed results of the analyses are illustrated in the Supporting Information B; Table S5.

3.5 | Negative effects of the intervention

In the INEP, there were some reports of potential negative effects of the internet-based intervention: six participants in the IG reported that they felt slightly (five) or mostly (one) forced to do something they did not want to do. Three participants of the IG had slight concerns regarding privacy, two reported on having less free time. One participant stated to be afraid of somebody finding out about the training, and one participant reported on feeling dependent on the training. Overall, 17 of the reported negative changes were attributed to the training (27%). More details on negative effects can be found in the Supporting Information B; Table S6.

4 | DISCUSSION

The present study is the first to examine a brief cognitive internet-based intervention to improve sleep difficulties among international college students. Our present results suggest that the used version of the intervention is effective for and accepted by international college students, although it had not been culturally adapted to fit their needs. We found the intervention effectively reducing insomnia severity in the IG as compared to the waitlist CG, with an effect of g = 0.84 ($p < 0.001$) 12 weeks after randomisation. Correspondingly, international students in the IG were satisfied with the intervention and perceived it as culturally appropriate, as revealed by ratings similar to those of a German comparison sample.

The present results are consistent with prior trials investigating psychological sleep interventions in domestic college students with a mean effect size of g = 0.61 (Saruhanjan et al., 2020), revealing similar effects of internet-based interventions on the improvement of sleep difficulties (e.g. Freeman et al., 2017). This pilot trial was conducted in a naturalistic setting including both a clinical and subclinical population, thus enhancing the potential health impact of the intervention. Only 7% of the sample can be considered non-clinical based on the ISI (Bastien et al., 2001; Table 1). The non-significant difference in insomnia severity between the IG and CG of g = 0.42 at the 4-week follow-up might be attributable to: (a) a small sample size in the present study, resulting in low power ($1-\beta = 0.46$). (b) Furthermore, baseline insomnia severity (mean 15.9, 95% CI 14.6 to 17.1) was lower than that in the studies investigating the original intervention among employees and teachers (mean 18.9, 95% CI 17.5 to 18.5, Ebert et al., 2015; mean 17.9, 95% CI 17.4 to 18.5, Thiart et al., 2015). Increased baseline severity is known to lead to higher treatment effects (Murawski, Wade, Plotnikoff, Lubans, & Duncan, 2018; Van Houdenhove, Buyse, Gabriëls, & Van Den Bergh, 2011), most possibly due to less room for improvement with lower baseline scores (Espie, Inglis, & Harvey, 2001). This is supported by the conducted post hoc analyses excluding participants without clinical insomnia, which revealed a significant between-group effect also at the 4-week follow-up of g = 0.52 (for details on conducted analyses see Supporting information B; Table S7). (c) The fact that only seven participants in the IG had finished the intervention by the time of the 4-week follow-up might have influenced the effectiveness of the intervention at that time. Completer analyses revealed a larger effect size of g = 1.09 in insomnia severity at the 12-week follow-up (see Supporting information B; Table S5).

Nonetheless, the revealed high effect at the 12-week follow-up, although smaller than the effect sizes of the original intervention in German employees and teachers (Ebert et al., 2015; Thiart et al., 2015), is rather surprising. First, our intervention differs significantly from evidence-based CBT interventions for insomnia (e.g. lack of contents on sleep restriction and stimulus control; Zachariae et al., 2016), due to the aim to provide an easy to implement brief intervention. Second, it contrasts with findings of reduced efficacy of culturally non-adapted internet-based interventions for other, non-student groups of culturally diverse people (Karyotaki et al., 2018). On the

TABLE 3 Results for the secondary outcomes

	IG		CG		Adjusted effect estimates			
	N	Observed, mean (*SD*)	*N*	Observed, mean (*SD*)	Mean difference (95% CI)	*p*	Hedges' g (95% CI)	Interaction test (time × group)
Sleep quality (PSQI)								
T1	41	9.0 (3.6)	40	9.5 (3.7)				$F_{2,62} = 4.77$, $p = 0.012$
T2	21	6.4 (3.6)	32	9.2 (3.4)	−2.5 (−4.2 to −0.8)	<0.01	0.64 (0.19 to 1.08)	
T3	21	5.4 (3.1)	31	8.7 (3.4)	−2.9 (−4.7 to −1.2)	<0.01	0.74 (0.29 to 1.19)	
Depressive symptoms (PHQ-8)								
T1	41	11.8 (5.5)	40	12.1 (6.2)				$F_{2,57} = 4.75$, $p = 0.012$
T2	22	9.4 (6.2)	32	11.1 (6.9)	−1.4 (−4.4 to 1.7)	0.375	0.20 (−0.24 to 0.63)	
T3	21	7.1 (5.3)	31	10.9 (6.4)	−3.7 (−6.7 to −0.8)	<0.05	0.56 (0.12 to 1.00)	
Anxiety symptoms (GAD-7)								
T1	37	9.3 (5.1)	37	11.1 (5.8)				$F_{2,57} = 0.68$, $p = 0.513$
T2	22	8.5 (4.8)	32	11.1 (6.1)	−2.0 (−4.7 to 0.7)	0.143	0.33 (−0.11 to 0.77)	
T3	21	6.2 (4.5)	31	9.7 (5.8)	−2.9 (−5.6 to −0.2)	<0.05	0.48 (0.04 to 0.92)	
Perceived stress (PSS-4)								
T1	41	8.3 (3.6)	40	8.0 (3.4)				$F_{2,57} = 4.12$, $p = 0.021$
T2	22	7.4 (3.8)	32	8.6 (3.5)	−1.2 (−2.9 to 0.5)	0.172	0.31 (−0.13 to 0.74)	
T3	21	6.1 (3.0)	31	7.4 (3.3)	−1.7 (−3.4 to 0.1)	0.064	0.42 (−0.02 to 0.86)	
General well-being (WHO-5)								
T1	41	38.9 (15.7)	40	36.6 (20.8)				$F_{2,52} = 6.24$, $p = 0.004$
T2	22	53.1 (19.0)	32	36.3 (21.3)	13.9 (5.0 to 22.9)	<0.01	−0.69 (−1.14 to −0.24)	
T3	21	50.1 (22.4)	31	42.2 (18.9)	7.4 (−3.3 to 17.8)	0.173	−0.30 (−0.74 to 0.13)	
Presenteeism (PSfS-Work Impairment)								
T1	41	51.6 (6.7)	40	52.6 (5.7)				$F_{2,69} = 0.10$, $p = 0.903$
T2	22	53.4 (3.9)	32	54.1 (5.2)	−0.3 (−2.8 to 2.3)	0.833	0.05 (−0.39 to 0.48)	
T3	21	53.4 (7.4)	31	54.1 (4.6)	−0.7 (−4.1 to 2.6)	0.657	0.10 (−0.34 to 0.54)	
Presenteeism (PSfS-Work Output)								
T1	41	57.2 (21.0)	40	60.8 (19.5)				$F_{2,65} = 3.10$, $p = 0.052$
T2	22	69.3 (15.1)	32	62.6 (17.3)	6.7 (−2.1 to 15.6)	0.133	−0.34 (−0.78 to 0.10)	
T3	21	69.1 (22.5)	31	63.2 (19.4)	7.4 (−3.1 to 17.8)	0.165	−0.31 (−0.75 to 0.13)	
Presenteeism (PSfS-Hours of Absenteeism)								
T1	41	27.0 (45.6)	40	21.0 (37.0)				$F_{2,69} = 1.90$, $p = 0.157$
T2	22	7.6 (9.1)	32	15.4 (35.1)	−6.9 (−22.4 to 8.5)	0.372	0.20 (−0.24 to 0.64)	
T3	21	8.2 (9.5)	31	20.8 (40.9)	−12.3 (−30.1 to 5.5)	0.171	0.31 (−0.13 to 0.75)	
Mental health literacy (MHLQ)								
T1	41	123.4 (9.0)	40	124.1 (10.1)				$F_{2,56} = 0.35$, $p = 0.706$
T2	22	120.6 (10.0)	32	120.8 (11.7)	1.6 (−3.4 to 6.5)	0.535	−0.14 (−0.57 to 0.30)	
T3	21	122.0 (10.8)	31	122.2 (11.0)	2.9 (−2.5 to 8.0)	0.268	−0.25 (−0.68 to 0.19)	

CG, control group; CI, confidence interval; GAD, Generalised Anxiety Disorder Scale (Spitzer et al., 2006); IG, intervention group; MHLQ, Mental Health Literacy Questionnaire in Young Adults (Dias et al., 2018); PHQ, Patient Health Questionnaire (Kroenke et al., 2009); PSfS, Presenteeism for Students Scale (Matsushita et al., 2011); PSQI, Pittsburgh Sleep Quality Index (Buysse et al., 1989); PSS, Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983); *SD*, standard deviation; T1, Baseline assessment; T2, 4-week follow-up assessment; T3, 12-week follow-up assessment; WHO-5, World Health Organisation Well-Being Index (Bech et al., 2001).

one hand, high socioeconomic status, education, and motivation in our sample may have led to the effectiveness of this brief cognitive intervention focussing on psychoeducation and rumination. This is compatible with the Saruhanjan et al. (2020) assumption that the effectiveness of sleep interventions differs between students and the general population, due to, e.g. differences in sleep rhythm and cognitive flexibility. On the other hand, the focus of the intervention on students might be of greater relevance for the target group than

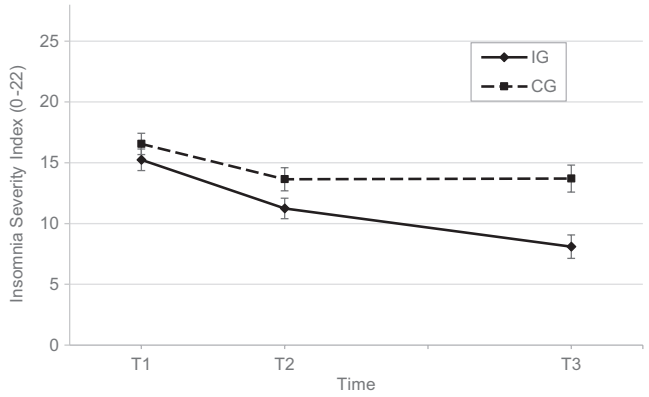


FIGURE 2 Model-based estimates of the Insomnia Severity Index (Bastien et al., 2001) mean scores in the intervention group (IG) and the control group (CG) at baseline (T1), 4-week follow-up assessment (T2), and 12-week follow-up assessment (T3). The model includes the factors time, group, and their interaction. The error bars represent the model estimated standard error of the mean

a possible focus on culturally diverse backgrounds. According to the diversity hypothesis, it is important to consider various aspects that are similar or different between people, and not to reduce certain features to cultural background alone (von Lersner & Kizilhan, 2017). In this respect, the revealed effectiveness of the intervention in international students might be attributable to commonalities between international and domestic students (e.g. having similar daily routines, being in similar peer groups, or facing similar difficulties), outweighing differences in cultural background and, thus, reducing the need for cultural adaptation.

Corresponding to this assumption and the effectiveness of the internet-based intervention, a high acceptance of it by the international students was shown. First, user satisfaction among the international students was high and did not differ significantly from German students' satisfaction. Second, the international students rated the internet-based intervention as culturally appropriate, with perceived cultural appropriateness scores even higher than those of the German comparison sample. Higher scores among the international students may be attributed to revealed higher levels of English skills and a more intense work on the internet-based intervention. Third, a medium completion rate of 43.9% among the international students reveals an adherence comparable with Ebert et al. (2015), who evaluated the respective internet-based sleep intervention in German teachers, as well as other unguided internet-based interventions (Karyotaki et al., 2021; Lancee, van den Bout, Sorbi, & van Straten, 2013) and other internet-based interventions among students (Freeman et al., 2017; Harrer, Adam, Fleischmann, et al., 2018; Kählke et al., 2019; Lattie et al., 2019).

Regarding secondary effectiveness outcomes, sleep quality after 4 and 12 weeks, depressive symptoms after 12 weeks, and general well-being after 4 weeks were significantly improved in the IG as compared to the CG. There were no significant effects of the intervention on anxiety symptoms, perceived stress, presenteeism, or mental health literacy. Revealed effects on depressive and anxiety symptoms, as well as perceived stress and general well-being, seem comparable to previous studies investigating internet-based interventions in college students (Harrer, Adam, Baumeister, et al., 2018). Based on the assumption of high levels of stress (Smith & Khawaja, 2011) and low mental health literacy among international students (Hyun et al., 2007), the lack of a significant effect on these aspects is somewhat surprising and could be addressed in future studies, investigating stressors and potential barriers specific to international students.

Some limitations of the present pilot study should be considered. First, generalisability of the conducted trial is limited due to a number of factors. (1) We addressed a highly educated and motivated sample of international students, which does not allow to draw conclusions on other groups of migrants or people living in low- and middle-income countries. (2) Due to the pilot character of the study, we did not define an adequately powered sample size a priori. Along with this, the power to detect rather small effects at T2 and in the secondary outcomes was low, with $1-\beta = 0.14–0.57$ and $g = 0.20–0.48$. (3) Adherence to the intervention was low and study discontinuation was high, with no assessment of corresponding reasons. Discontinuation rates were greater in the IG, potentially leading to a highly motivated IG sample. Although the intervention completion and study attrition rates seem comparable to other trials evaluating internet-based interventions among students (Harrer, Adam, Baumeister, et al., 2018; Harrer, Adam, Fleischmann, et al., 2018), this might have affected the results in favour of the IG. However, completion and attrition analyses did not reveal any significant baseline differences between study discontinuation and non-discontinuation participants, nor between intervention completers and non-completers, which might indicate that the results were not excessively biased (Bell, Kenward, Fairclough, & Horton, 2013). Second, the waitlist CG design may have biased the results towards a larger effect, as such a design generally shows larger effect sizes than comparisons with an active or treatment-as-usual CG (Furukawa et al., 2014). This may be due to a lower tendency of the CG to seek help elsewhere, given the perspective of receiving treatment after the waiting period (Mohr et al., 2014). Indeed, seeking psychological help seemed to be equally low in the CG and IG over the course of the study (Table 1). Third, given the unguided character of the intervention, it was not recorded which elements and exercises of the intervention were completed, and how thoroughly they were completed, which could bias the illustrated intervention completion rates. Fourth, the validity of comparing satisfaction and perceived cultural appropriateness in international and German students may be limited, due to differences in their age and gender ratio, and likely differences in the motivation to participate in the study: international students participated to improve their sleep difficulties, whereas German students participated to help improve the cultural appropriateness of the intervention. Fifth, we only inferred on the cultural background of the students through nationality, which may not be valid. Sixth, we did not distinguish between international college students in terms of, e.g. duration of stay in Germany, level of acculturation, or nationality (culturally close versus different from Germany). However, these aspects might have an influence on the necessity of cultural adaptation of internet-based interventions and, thus, their effectiveness (von Lersner & Kizilhan, 2017).

To address the named limitations, a fully powered randomised controlled trial based on this pilot study should be conducted, comparing the acceptance and effectiveness of the culturally non-adapted intervention with a culturally adapted version among a diverse sample of international students. To test various versions of interventions with different degrees of adaptation, randomised factorial trials could be conducted (Collins, 2018; Watkins & Newbold, 2020). Such direct comparison trials are lacking, but are essential for further conclusions on the necessity of cultural adaptation in specific target groups (Harper Shehadeh et al., 2016; Heim & Kohrt, 2019; Ramos & Chavira, 2019; Spanhel et al., 2021). Thus, differences in the necessity of cultural adaptation, uptake, acceptance, or effectiveness between subgroups of international students could be investigated. Such research questions could also be evaluated by using routine service data from the StudiCare consortium (e.g. Ebert et al., 2019; Harrer, Adam, Fleischmann, et al., 2018; Kählke et al., 2019), where college students get free access to internet-based interventions to improve their mental health.

In conclusion, we found that a culturally non-adapted brief cognitive internet-based intervention effectively reduced insomnia severity among international college students. Together with acceptance levels comparable to German students, this suggests that students with a differing cultural background can benefit from an internet-based intervention even without cultural adaptation. Providing such interventions, e.g. through the StudiCare consortium, can thus be a low-threshold solution that helps overcome barriers to mental healthcare for international college students, as proposed by the WHO World Mental Health International College Student initiative (Cuijpers et al., 2019). Such a provision could allow investigating the uptake of these offers, and, thus, possible differences in the necessity of cultural adaptation.

ACKNOWLEDGEMENTS

The authors wish to thank Valentina Jehn for collecting the additional data of the German student sample, Friederike Raschtuttis for her help on manuscript preparation, and Lia York for language editing. Further thanks go to all of our study participants, as well as the StudiCare project, and all universities who forwarded the information on our study. KeS is supported by the German Academic Scholarship Foundation. Open Access funding provided by Projekt DEAL. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

CONFLICT OF INTEREST

Authors of the manuscript were partly involved in the development of StudiCare Sleep-e or its predecessor versions. KeS, DB, TP, KaS, and JB declare that they have no competing interests. DL and DDE. are stakeholders of the GET.ON Institute for Online Health Training, Hamburg, which aims to transfer scientific knowledge related to this field of research into routine mental healthcare in Germany. This institute is licensed to provide the original German version of the intervention from the Leuphana University, Lueneburg, as part of routine preventive services covered by health insurance companies in Germany. DDE reports to have received consultancy fees or served in the scientific advisory board from several companies such as Minddistrict, Sanofi, Lantern, Schön Kliniken, German health insurance companies (BARMER and Techniker Krankenkasse), and chambers of psychotherapists. HB received consultancy fees, reimbursement of congress attendance, and travel costs as well as payments for lectures from Psychotherapy and Psychiatry Associations, as well as Psychotherapy Training Institutes in the context of E-Mental-Health topics. He has been the beneficiary of study support (third-party funding) from several public funding organisations. LBS received personal fees from Psychotherapy Training Institutes and clinics in the context of E-Mental-Health topics and supervision outside the submitted work.

AUTHOR CONTRIBUTIONS

KeS, HB, JB, and LBS conceived the study design. DL provided the intervention template GET.ON Recovery, KeS, DB, and LBS adapted the intervention content. DDE provided access to the study on the StudiCare platform. KaS provided expertise in sleep problems and treatment. KeS, DB, and TP collected data, conducted the statistical analyses, and wrote the draft of the manuscript. JB and LBS supervised the work. All authors approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Kerstin Spanhel https://orcid.org/0000-0002-4889-1274
Dirk Lehr https://orcid.org/0000-0002-5560-3605
David D. Ebert https://orcid.org/0000-0001-6820-0146
Harald Baumeister https://orcid.org/0000-0002-2040-661X
Lasse B. Sander https://orcid.org/0000-0002-4222-9837

REFERENCES

Ashworth, D. K., Sletten, T. L., Junge, M., Simpson, K., Clarke, D., Cunnington, D., & Rajaratnam, S. M. W. (2015). A randomized controlled trial of cognitive behavioral therapy for insomnia: an effective treatment for comorbid insomnia and depression. *Journal of Counseling Psychology*, *62*(2), 115–123. https://doi.org/10.1037/cou0000059

Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., Green, J. G., … Bruffaerts, R. (2016). Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychological Medicine*, *46*(14), 2955–2970. https://doi.org/10.1017/S0033291716001665

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

Bech, P., Olsen, L. R., Kjoller, M., & Rasmussen, N. K. (2001). Measuring well-being rather than the absence of distress symptoms: a comparison of the SF-36 Mental Health subscale and the WHO-Five well-being scale. *International Journal of Methods in Psychiatric Research*, *12*(2), 85–91. https://doi.org/10.1002/mpr.145

Bell, M. L., Kenward, M. G., Fairclough, D. L., & Horton, N. J. (2013). Differential dropout and bias in randomised controlled trials: when it matters and when it may not. *BMJ*, *346*, e8668. https://doi.org/10.1136/bmj.e8668

Boß, L., Lehr, D., Reis, D., Vis, C., Riper, H., Berking, M., & Ebert, D. D. (2016). Reliability and validity of assessing user satisfaction with web-based health interventions. *Journal of Medical Internet Research*, *18*(8), e234. https://doi.org/10.2196/jmir.5952

Buntrock, C., Ebert, D. D., Lehr, D., Smit, F., Riper, H., Berking, M., & Cuijpers, P. (2016). Effect of a web-based guided self-help intervention for prevention of major depression in adults with subthreshold depression a randomized clinical trial. *JAMA*, *315*(17), 1854–1863. https://doi.org/10.1001/jama.2016.4326

Buysse, D. J., Ancoli-Israel, S., Edinger, J., Lichstein, K., & Morin, C. (2006). Recommendations for a standard research assessment of insomnia. *Sleep*, *29*(9), 1155–1173. https://doi.org/10.1093/sleep/29.9.1155

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Chan, N. Y., Li, S. X., Zhang, J., Lam, S. P., Kwok, A. P. L., Yu, M. W. M., … Wing, Y. K. (2021). A prevention program for insomnia in at-risk adolescents: a randomized controlled study. *Pediatrics*, *147*(3), e2020006833. https://doi.org/10.1542/PEDS.2020-006833

Clough, B. A., Nazareth, S. M., & Casey, L. M. (2020). Making the grade: a pilot investigation of an e-intervention to increase mental health literacy and help-seeking intentions among international university students. *British Journal of Guidance and Counselling*, *48*(3), 347–359. https://doi.org/10.1080/03069885.2019.1673312

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385–396. https://doi.org/10.2307/2136404

Collins, L. M. (2018). *Optimization of behavioral, biobehavioral, and biomedical interventions: the multiphase optimization strategy (MOST)*, 1st ed. Springer International Publishing. https://doi.org/10.1007/978-3-319-72206-1

Colvonen, P. J., Straus, L. D., Stepnowsky, C., McCarthy, M. J., Goldstein, L. A., & Norman, S. B. (2018). Recent advancements in treating sleep disorders in co-occurring PTSD. *Current Psychiatry Reports*, *20*(7), 48. https://doi.org/10.1007/s11920-018-0916-9

Cuijpers, P., Auerbach, R. P., Benjet, C., Bruffaerts, R., Ebert, D. D., Karyotaki, E., & Kessler, R. C. (2019). The World Health Organization World Mental Health International College Student initiative: an overview. *International Journal of Methods in Psychiatric Research*, *28*(2), e1761. https://doi.org/10.1002/mpr.1761

Dias, P., Campos, L., Almeida, H., & Palha, F. (2018). Mental health literacy in young adults: adaptation and psychometric properties of the mental health literacy questionnaire. *International Journal of Environmental Research and Public Health*, *15*(7), 1318–1330. https://doi.org/10.3390/ijerph15071318

Ebert, D. D., Berking, M., Thiart, H., Riper, H., Laferton, J. A. C., Cuijpers, P., … Lehr, D. (2015). Restoring depleted resources: efficacy and mechanisms of change of an internet-based unguided recovery training for better sleep and psychological detachment from work. *Health Psychology*, *34*(Suppl), 1240–1251. https://doi.org/10.1037/hea0000277

Ebert, D. D., Mortier, P., Kaehlke, F., Bruffaerts, R., Baumeister, H., Auerbach, R. P., … Kessler, R. C. (2019). Barriers of mental health treatment utilization among first-year college students: first cross-national results from the WHO World Mental Health International College Student Initiative. *International Journal of Methods in Psychiatric Research*, *28*(6), e1782. https://doi.org/10.1002/mpr.1782

Espie, C. A., Inglis, S. J., & Harvey, L. (2001). Predicting clinically significant response to cognitive behavior therapy for chronic insomnia in general medical practice: analyses of outcome data at 12 months posttreatment. *Journal of Consulting and Clinical Psychology*, *69*(1), 58–66. https://doi.org/10.1037/0022-006X.69.1.58

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

Furukawa, T. A., Noma, H., Caldwell, D. M., Honyashiki, M., Shinohara, K., Imai, H., … Churchill, R. (2014). Waiting list may be a nocebo condition in psychotherapy trials: a contribution from network meta-analysis. *Acta Psychiatrica Scandinavica*, *130*(3), 181–192. https://doi.org/10.1111/acps.12275

Harper Shehadeh, M. J., Heim, E., Chowdhary, N., Maercker, A., & Albanese, E. (2016). Cultural adaptation of minimally guided interventions for common mental disorders: a systematic review and meta-analysis. *JMIR Mental Health*, *3*(3), e44. https://doi.org/10.2196/mental.5776

Harrer, M., Adam, S. H., Baumeister, H., Cuijpers, P., Karyotaki, E., Auerbach, R. P., … Ebert, D. D. (2018). Internet interventions for mental health in university students: a systematic review and meta-analysis. *International Journal of Methods in Psychiatric Research*, *28*(2), e1759. https://doi.org/10.1002/mpr.1759

Harrer, M., Adam, S. H., Fleischmann, R. J., Baumeister, H., Auerbach, R., Bruffaerts, R., … Ebert, D. D. (2018). Effectiveness of an internet- and app-based intervention for college students with elevated stress: randomized controlled trial. *Journal of Medical Internet Research*, *20*(4), e136. https://doi.org/10.2196/jmir.9293

Hedges, L., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Academic Press Inc.

Heim, E., & Kohrt, B. A. (2019). Cultural adaptation of scalable psychological interventions: a new conceptual framework. *Clinical Psychology in Europe*, *1*(4), e37679. https://doi.org/10.32872/cpe.v1i4.37679

Hyun, J., Quinn, B., Madon, T., & Lustig, S. (2007). Mental health need, awareness, and use of counseling services among international graduate students. *Journal of American College Health*, *56*(2), 109–118. https://doi.org/10.3200/JACH.56.2.109-118

Jiang, X. L., Zheng, X. Y., Yang, J., Ye, C. P., Chen, Y. Y., Zhang, Z. G., & Xiao, Z. J. (2015). A systematic review of studies on the prevalence of insomnia in university students. *Public Health*, *129*(12), 1579–1584. https://doi.org/10.1016/j.puhe.2015.07.030

Kählke, F., Berger, T., Schulz, A., Baumeister, H., Berking, M., Auerbach, R. P., … Ebert, D. D. (2019). Efficacy of an unguided internet-based self-help intervention for social anxiety disorder in university students: a randomized controlled trial. *International Journal of Methods in Psychiatric Research*, *28*(2), e1766. https://doi.org/10.1002/mpr.1766

Kanekar, A., Sharma, M., & Atri, A. (2010). Enhancing social support, hardiness, and acculturation to improve mental health among Asian Indian international students. *International Quarterly of Community Health Education*, *30*(1), 55–68. https://doi.org/10.2190/IQ.30.1.e

Karyotaki, E., Ebert, D. D., Donkin, L., Riper, H., Twisk, J., Burger, S., … Cuijpers, P. (2018). Do guided internet-based interventions result in clinically relevant changes for patients with depression? An individual participant data meta-analysis. *Clinical Psychology Review*, *63*, 80–92. https://doi.org/10.1016/j.cpr.2018.06.007

Karyotaki, E., Efthimiou, O., Miguel, C., Bermpohl, F. M. G., Furukawa, T. A., Cuijpers, P., … Forsell, Y. (2021). Internet-based cognitive behavioral therapy for depression: a systematic review and individual patient data network meta-analysis. *JAMA Psychiatry*, *78*(4), 361. https://doi.org/10.1001/jamapsychiatry.2020.4364

Kroenke, K., Strine, T. W., Spitzer, R. L., Williams, J. B. W., Berry, J. T., & Mokdad, A. H. (2009). The PHQ-8 as a measure of current depression in the general population. *Journal of Affective Disorders*, *114*(1–3), 163–173. https://doi.org/10.1016/j.jad.2008.06.026

Ladwig, I., Rief, W., & Nestoriuc, Y. (2014). What are the risks and side effects of psychotherapy? – Development of an inventory for the assessment of negative effects of psychotherapy (INEP). *Verhaltenstherapie*, *24*(4), 252–263. https://doi.org/10.1159/000367928

Lancee, J., van den Bout, J., Sorbi, M. J., & van Straten, A. (2013). Motivational support provided via email improves the effectiveness

of internet-delivered self-help treatment for insomnia: a randomized trial. *Behaviour Research and Therapy*, *51*(12), 797–805. https://doi.org/10.1016/j.brat.2013.09.004

Lattie, E. G., Adkins, E. C., Winquist, N., Stiles-Shields, C., Wafford, Q. E., & Graham, A. K. (2019). Digital mental health interventions for depression, anxiety and enhancement of psychological well-being among college students: systematic review. *Journal of Medical Internet Research*, *21*(7), e12869. https://doi.org/10.2196/12869

Matsushita, M., Adachi, H., Arakida, M., Namura, I., Takahashi, Y., Miyata, M., … Sugita, Y. (2011). Presenteeism in college students: reliability and validity of the presenteeism scale for students. *Quality of Life Research*, *20*(3), 439–446. https://doi.org/10.1007/s11136-010-9763-9

Mohr, D. C., Ho, J., Hart, T. L., Baron, K. G., Berendsen, M., Beckner, V., … Duffecy, J. (2014). Control condition design and implementation features in controlled trials: a meta-analysis of trials evaluating psychotherapy for depression. *Translational Behavioral Medicine*, *4*(4), 407–423. https://doi.org/10.1007/s13142-014-0262-3

Muñoz, R. F., Chavira, D. A., Himle, J. A., Koerner, K., Muroff, J., Reynolds, J., … Schueller, S. M. (2018). Digital apothecaries: a vision for making health care interventions accessible worldwide. *mHealth*, *4*, 18. https://doi.org/10.21037/mhealth.2018.05.04

Murawski, B., Wade, L., Plotnikoff, R. C., Lubans, D. R., & Duncan, M. J. (2018). A systematic review and meta-analysis of cognitive and behavioral interventions to improve sleep health in adults without sleep disorders. *Sleep Medicine Reviews*, *40*, 160–169. https://doi.org/10.1016/j.smrv.2017.12.003

Pressler, S. J., Subramanian, U., Perkins, S. M., Gradus-Pizlo, I., Kareken, D., Kim, J., … Sloan, R. (2011). Measuring depressive symptoms in heart failure: validity and reliability of the patient health questionnaire-8. *American Journal of Critical Care*, *20*(2), 146–152. https://doi.org/10.4037/ajcc2010931

Pusztai, D., Rozmann, N., Horváth, É., Szunomár, S., & Fusz, K. (2019). Health behavior, sleep quality and subjective health status of foreign students in Hungary. *Archives of Psychiatric Nursing*, *33*(5), 83–87. https://doi.org/10.1016/j.apnu.2019.06.002

Rahmadiana, M., Karyotaki, E., Schulte, M., Ebert, D. D., Passchier, J., Cuijpers, P., … Riper, H. (2021). Transdiagnostic internet intervention for Indonesian university students with depression and anxiety: evaluation of feasibility and acceptability. *JMIR Mental Health*, *8*(3), e20036. https://doi.org/10.2196/20036

Ramos, G., & Chavira, D. A. (2019). Use of technology to provide mental health care for racial and ethnic minorities: evidence, promise, and challenges. *Cognitive and Behavioral Practice*, Online ahead of print. https://doi.org/10.1016/j.cbpra.2019.10.004

Ribeiro, Í. J. S., Pereira, R., Freire, I. V., de Oliveira, B. G., Casotti, C. A., & Boery, E. N. (2018). Stress and quality of life among university students: a systematic literature review. *Health Professions Education*, *4*(2), 70–77. https://doi.org/10.1016/j.hpe.2017.03.002

Ryan, M. L., Shochet, I. M., & Stallman, H. M. (2010). Universal online interventions might engage psychologically distressed university students who are unlikely to seek formal help. *Advances in Mental Health*, *9*(1), 73–83. https://doi.org/10.5172/jamh.9.1.73

Salamanca-Sanabria, A., Richards, D., Timulak, L., Connell, S., Mojica Perilla, M., Parra-Villa, Y., & Castro-Camacho, L. (2020). A culturally adapted cognitive behavioral internet-delivered intervention for depressive symptoms: randomized controlled trial. *JMIR Mental Health*, *7*(1), e13392. https://doi.org/10.2196/13392

Sander, L., Rausch, L., & Baumeister, H. (2016). Effectiveness of internet-based interventions for the prevention of mental disorders: a systematic review and meta-analysis. *JMIR Mental Health*, *3*(3), e38. https://doi.org/10.2196/mental.6061

Saruhanjan, K., Zarski, A.-C., Bauer, T., Baumeister, H., Cuijpers, P., Spiegelhalder, K., … Ebert, D. D. (2020). Psychological interventions to improve sleep in college students: a meta-analysis of randomized controlled trials. *Journal of Sleep Research*, *30*(1), e13097. https://doi.org/10.1111/jsr.13097

Scheppers, E., van Dongen, E., Dekker, J., Geertzen, J., & Dekker, J. (2006). Potential barriers to the use of health services among ethnic minorities: a review. *Family Practice*, *23*(3), 325–348. https://doi.org/10.1093/fampra/cmi113

Skromanis, S., Cooling, N., Rodgers, B., Purton, T., Fan, F., Bridgman, H., … Mond, J. (2018). Health and well-being of international university students, and comparison with domestic students, in Tasmania, Australia. *International Journal of Environmental Research and Public Health*, *15*(6), 1147–1160. https://doi.org/10.3390/ijerph15061147

Smith, R. A., & Khawaja, N. G. (2011). A review of the acculturation experiences of international students. *International Journal of Intercultural Relations*, *35*(6), 699–713. https://doi.org/10.1016/j.ijintrel.2011.08.004

Spanhel, K., Balci, S., Feldhahn, F., Bengel, J., Baumeister, H., & Sander, L. B. (2021). Cultural adaptation of internet- and mobile-based interventions for mental disorders: a systematic review. *npj Digital Medicine*, *4*, 128. https://doi.org/10.1038/s41746-021-00498-1

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine*, *166*(10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092

Thiart, H., Lehr, D., Ebert, D. D., Berking, M., & Riper, H. (2015). Log in and breathe out: Internet-based recovery training for sleepless employees with work-related strain – results of a randomized controlled trial. *Scandinavian Journal of Work, Environment and Health*, *41*(2), 164–174. https://doi.org/10.5271/sjweh.3478

Van Houdenhove, L., Buyse, B., Gabriëls, L., & Van Den Bergh, O. (2011). Treating primary insomnia: clinical effectiveness and predictors of outcomes on sleep, daytime function and health-related quality of life. *Journal of Clinical Psychology in Medical Settings*, *18*(3), 312–321. https://doi.org/10.1007/s10880-011-9250-7

von Lersner, U., & Kizilhan, J. I. (2017). *Kultursensitive Psychotherapie [Culture-sensitive psychotherapy]. Fortschritte der Psychotherapie* (vol. *64*, 1st edn). Hogrefe. https://doi.org/10.1026/02755-000

Warttig, S. L., Forshaw, M. J., South, J., & White, A. K. (2013). New, normative, English-sample data for the short form perceived stress scale (PSS-4). *Journal of Health Psychology*, *18*(12), 1617–1628. https://doi.org/10.1177/1359105313508346

Watkins, E. R., & Newbold, A. (2020). Factorial designs help to understand how psychological therapy works. *Frontiers in Psychiatry*, *11*, 429. https://doi.org/10.3389/fpsyt.2020.00429

Zachariae, R., Lyby, M. S., Ritterband, L. M., & O'Toole, M. S. (2016). Efficacy of internet-delivered cognitive-behavioral therapy for insomnia - a systematic review and meta-analysis of randomized controlled trials. *Sleep Medicine Reviews*, *30*, 1–10. https://doi.org/10.1016/j.smrv.2015.10.004

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Spanhel, K., Burdach, D., Pfeiffer, T., Lehr, D., Spiegelhalder, K., Ebert, D. D., Baumeister, H., Bengel, J., & Sander, L. B. (2022). Effectiveness of an internet-based intervention to improve sleep difficulties in a culturally diverse sample of international students: A randomised controlled pilot study. *Journal of Sleep Research*, 31, e13493. https://doi.org/10.1111/jsr.13493