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Original Article

The effects of brief chat-based and face-to-face psychotherapy for insomnia: a randomized waiting list controlled trial

Annika Gieselmann*, Reinhard Pietrowsky

Department of Clinical Psychology, Heinrich Heine University Düsseldorf, Düsseldorf, Germany

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ABSTRACT

Background: Recent studies have directly compared the effects of Internet-based self-help interventions with face-to-face (FtF) treatment, but groups may also differ regarding other aspects, aside from the fact that the former is online and the latter offline. Thus, we examined the effects of a brief three-session psychotherapy for insomnia that was delivered FtF or through synchronous text-based chats.

Methods: Seventy-three patients diagnosed with insomnia were randomized to either FtF treatment, a chat-based treatment, or to a waiting list control group (WL). Treatment included topics that covered imagination, sleep restriction, sleep hygiene, repetition, and consolidation.

Results: Compared to WL, patients in both groups improved regarding sleep quality (d_{FtF} = 1.02, d_{chat} = 1.69) and improvements remained at the two-month follow-up (FU; d_{FtF} = 1.18, d_{chat} = 2.40). Improvements in actigraphic sleep onset latency that had been gained at the post-test time point, disappeared at FU, while subjective improvements remained. At FU, patients in the chat group outperformed FtF patients regarding subjective total sleep time, anxiety, depression, and cognitive pre-sleep arousal.

Conclusion: Three sessions were efficacious in treating insomnia, and the chat-based treatment slightly outperformed FtF treatment. This may be caused by the highly individualized treatment approach, by the fact that chatting forces both patients and therapists to adhere to the essence of the treatment goal, by increased feelings of privacy, autonomy, and a sense of felt responsibility for treatment. These hypotheses should be validated in future studies. So far, we can summarize that chat-based communication facilitates the treatment of patients who cannot or who do not want to attend FtF treatment.

With a one-year prevalence of 7–20% of the general public in Europe and North America, insomnia was recently found to be the second most common mental disorder [1,2]. According to the fifth revision of the Diagnostic and Statistical Manual of Mental Disorders, DSM-5 [3], episodic insomnia disorder refers to the difficulty in initiating sleep, maintaining sleep and/or early-morning awakening with the inability to return to sleep. These complaints go together with impairments of daytime functioning and they last for at least four weeks. Though exact symptoms vary over time [4], the overall strain caused by these sleep difficulties was found to remain relatively stable [4,5], and the consultation rates of individuals concerned remained high [6,7].

To add to our knowledge of sleep treatment, the current paper reports results from a brief three-session psychotherapy treatment for insomnia that was either delivered face-to-face (FtF) or via a text-based Internet chat. The two groups were tested against a waiting list control group (WL) regarding subjective and objective (ie, actigraphic) measures of sleep quality and daytime functioning.

Insomnia is often treated with medication, although prescribed sleep medicine as a stand-alone intervention or in addition to Cognitive Behavior Therapy (CBT) is not predictive of improvements in sleep quality [8,9], whereas CBT alone significantly improved sleep quality with high, robust and sustained improvements [10–13]. Still, the application of CBT to patients suffering from insomnia remains rather low [1,14] and we are not aware of any fundamentally new data. Therefore, the application of CBT delivered as an Internet-based intervention may improve access to evidence-based treatment [15,16]. Most Internet-based

* Corresponding author.
E-mail address: Annika.Gieselmann@uni-duesseldorf.de (A. Gieselmann).

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interventions are delivered as guided or unguided self-help by using a content management system, whereby patients can log in to obtain access to particular information, exercises, and training. Though a recent meta-analysis attested to lower efficacy of self-help compared to FtF interventions in the treatment of insomnia [13]. In addition, demonstrated that self-help interventions that included guidance by a therapist improved treatment efficacy in insomnia when compared to pure unguided self-help interventions [17,18]. Regarding other mental disorders, the treatment efficacy of guided self-help did not differ from FtF interventions [eg, 19,20]. Concerning insomnia, results are mixed, but slightly in favor of FtF therapy. We are aware of five trials that directly compared Internet-based self-help with FtF treatment. Results ranged from no differences between Internet-based and group-delivered FtF interventions at all [21] to a slight, but non-significant differences in favor of group CBT [22,23]. Another trial demonstrated slightly superior performance of individual FtF therapy [24], and in a fifth trial, individualized FtF therapy outperformed the Internet-based intervention [25].

These results should be considered against the background that differences in FtF interventions and Internet-based self-help interventions might also be caused by other factors aside from the fact that the former is offline and the latter online. Former trials reported slight differences in the treatments delivered, different time lags between the sessions, compared group with individual treatment, and consisted of different therapists who conducted the different intervention arms [cf 24]. Therapeutic feedback in the course of the described Internet-based self-help interventions differs substantially from feedback delivered FtF, as Internet-based feedback is commonly asynchronous and mainly reinforcing and self-efficacy shaping [26]. Furthermore, the content management system itself might have influenced treatment outcome in the Internet-based group [ie, by the web-design, novelty, the quality of interactive tasks provided within the system, etc.; 27,28]. Such factors may confound the comparability of offline vs. online communication.

To address these factors, a trial was established that contained computer-mediated communication that consisted of synchronous text-based chat. During the chat, the patient and therapist communicated by text, without visual or auditory therapist cues. Although this is the most frequently used method of delivery in Internet-based interventions, there are only a few published trials that addressed its efficacy [29]. Chat-based communication is more comparable to common FtF interventions than to Internet-based self-help, although it does not have the advantage of minimizing therapist resources. However, it allows the designing of interventions with comparable settings and procedures that only differ regarding their communication form [30]. Compared to FtF, chat-based communication provides visual anonymity, increases self-awareness and the focus on one's own thoughts and feelings [31–33].

Patients received a brief three-session psychotherapy treatment for insomnia that was either delivered FtF or through a synchronous text-based Internet chat. Both intervention groups were compared to WL and monitored utilizing various measures of sleep quality and daytime symptoms. It was expected that both the FtF intervention and the chat-based intervention would equally improve primary sleep outcomes compared to WL as assessed by the Pittsburgh Sleep Quality Index (PSQI), as well as improve secondary sleep outcomes as assessed by a sleep diary and an actigraphic device. Because therapist factors improved treatment outcome in sleep-related outcomes measures, such as daytime functioning and sleep-related psychological strain [cf 34], it was expected that FtF would outperform the chat-based intervention.

1. Method

1.1. Patients

Participants were recruited through flyers and posters distributed on the university campus, medical practices, and pharmacies, through a study homepage, and social media. Interested readers were offered the possibility to participate in a trial that compared the effects of two interventions that were either delivered FtF or delivered chat-based. Inclusion criteria were: (a) insomnia disorder as diagnosed according to the research criteria for primary insomnia [35], (b) the presence of quantitative criteria, ie, a sleep latency of >30 min for at least three nights a week over the last six months [36], and (c) age of 18 + years. Exclusion criteria were: (a) the presence of other sleep disorders such as sleep apnea, narcolepsy, sleep wandering, night terror, bruxism, nightmares, restless legs syndrome, or sleep disorders due to a medical condition such as chronic pain [diagnosed according to the Structured Interview for Sleep Disorders SIS-D; 37], (b) sleep disorders caused by circadian problems and shift work, (c) regular alcohol or drug consumption (≥4 glasses/day for at least 21 days/month), (d) epilepsy, and (e) suicidal ideation, schizophrenia, and other severe psychiatric disorders [as diagnosed by a short version of the Structured Clinical Interview for DSM-IV Mini-DIPS; 38]. Other comorbid psychiatric disorders were tolerated, though the sleep complaints had to dominate the symptoms. In a similar vein, sleep medication and other psychotropic medications were tolerated, though the patients were asked to take their medicine regularly and to maintain the dosage during treatment. Participants were not financially compensated for their participation. 41% (n = 73) of those who declared an interest (N = 179) were randomized to one of the treatment groups. 32% (n = 57) were excluded after the telephone screening, 17% (n = 31) dropped out of their own accord, and 10% (n = 18) were excluded after FtF diagnostic investigation (see Fig. 1).

1.2. Procedure

The current trial was approved by the institutional review board and registered in the German Clinical Trials Register (DRKS00010522). A first telephone interview was conducted with patients who expressed interest to participate in the study. Patients who fulfilled the inclusion criteria were called back to schedule an FtF diagnostic interview and received a postal letter including a written confirmation of the scheduled interview as well as a written confirmation of the procedure of the study, inclusion and exclusion criteria, the process of randomization as well as possible side effects, and privacy protection. They signed a consent form that was handed in at the diagnostic session. The diagnostic interview included the Structured Interview for Sleep Disorders SIS-D [37] and a short version of the Structured Clinical Interview for DSM-IV Mini-DIPS, Axis I [38]; it was conducted by a licensed psychotherapist and a psychotherapist in training under supervision. Though the diagnostician followed the wording of the structured interviews, the diagnosis was given according to the research criteria for primary insomnia [35] and the DSM-5 criteria [American Psychiatric Association; 3]. List randomization took place after the diagnostic interview and was stratified by gender due to differences in men and women's written communication styles [39]. Eligible patients were introduced to the pre-test, the sleep diary and the actigraphic device, which they were asked to wear for one week to conduct the pre-test. The patients received the intervention either FtF (n = 27), or chat-based (chat, n = 23), or they were placed on a waiting list (WL, n = 22). The wait-listed patients started treatment after patients completed the post-test (see Fig. 1).

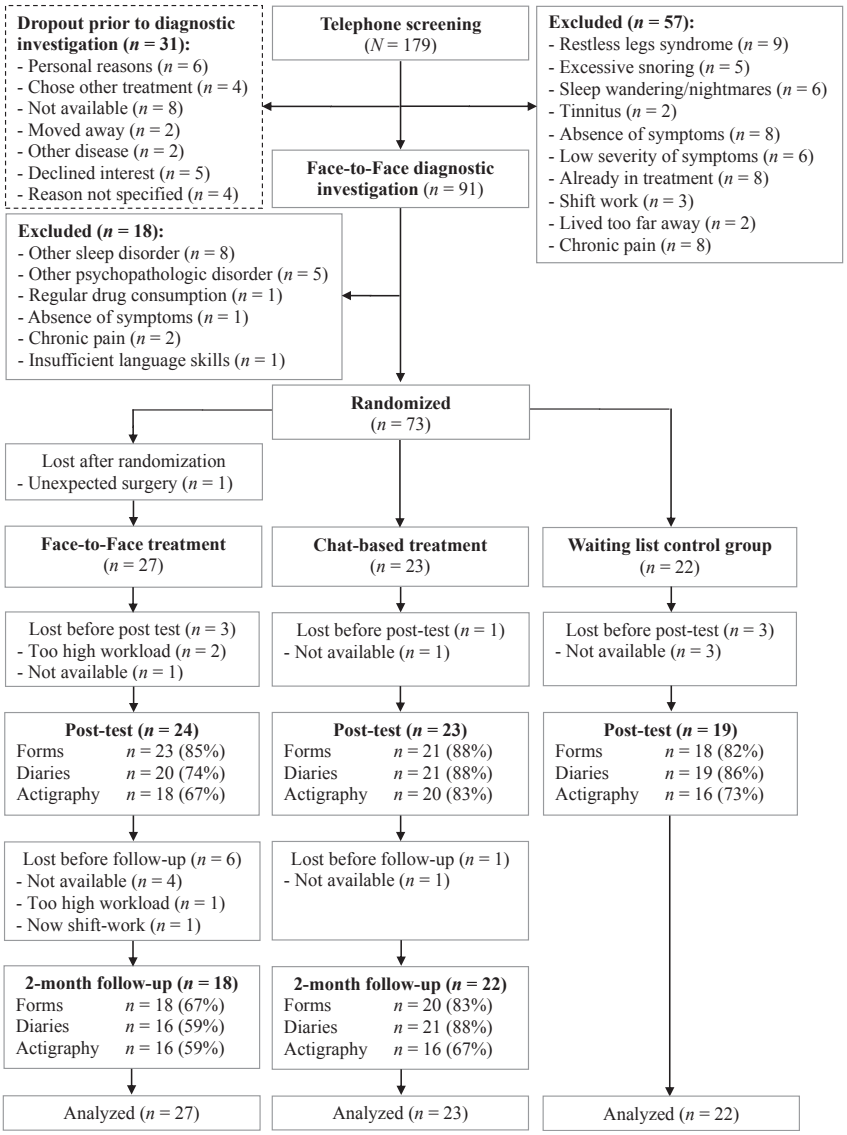

Fig. 1. Flow chart showing patient selection and drop-out.

WL patients decided for themselves which treatment they preferred and always chose the FtF intervention.

1.3. Intervention

FtF interventions and chat-based interventions were both conducted as individualized personal sessions using the same material and consisted of three sessions over four weeks. Each FtF patient sat together with the therapist in one room and communicated orally; each chat patient was spatially separated from the therapist and communicated through a synchronous online text chat offered by Skype Communications SARL; emoticons were used, but telephone calls and audiovisual communication were strictly prohibited to avoid any verbal or preverbal communication between patient and therapist.

The sessions consisted of an imagination exercise (session 1), information about sleep hygiene and sleep restriction (session 2), and a session for questions, repetition of the learned content, and for personal evaluation (session 3). Sessions were conducted by one of the eight female therapists, three of whom were psychology students shortly before completing their Master's degree and the remaining five were graduated psychologists in advanced training for their license as a psychotherapist. All therapists conducted an equal number of FtF interventions and chat-based interventions, $\chi^2(4) = 0.70$, $p = 0.952$. Treatment quality and adherence to the treatment protocol was assured by continuous supervision by a licensed psychotherapist.

1.3.1. Imagination (session 1)

After having explained the diagnosis and information on primary insomnia, the patient and therapist discussed the sleep protocol of the preceding week and established an individualized model to explain his or her symptoms by completing a vicious circle. The imagination exercise was introduced as a means to overcome the endless routines of the vicious circle. The patients and their respective therapists listened to an audiotape, which was introduced as an “imaginary journey to my healthy self” and contained an encounter with one's alter ego who has already overcome the sleep problems and now encourages the patient that he or she will also make it. At the end of the imagination exercise, the patient was motivated to use a reminding sign or a particular body movement to anchor the thoughts and feelings obtained during the

imagination exercise. The imagination exercise was recorded on an audio CD and participants were asked to listen to it daily the following week. To facilitate its execution, the patients finished the session with the formulated intention when and where they planned to do so. Session 2 was scheduled for the following week.

1.3.2. Sleep restriction & sleep hygiene (session 2)

Material that was taken from Müller and Paterok [40] on sleep hygiene and sleep restriction was introduced as a second approach to treat insomnia. The aim was to restrict the time in bed to avoid lying awake in bed for longer periods of time. Based on the sleep diary of the previous week, patients calculated the number of hours slept, which in turn formed their sleep window for the following week. If sleep efficiency (SE) exceeded 85%, they were allowed to broaden the sleep window by 15 min. Recommendations on sleep hygiene were handed out, and patients decided on three to four rules that they felt worth trying. As sleep restriction requires some time to make an impact [40], the third session was scheduled for two weeks after the second session.

1.3.3. Revision and consolidation (session 3)

The final session was conducted two weeks after Session 2 and included an evaluation of the experiences patients had with imagination and sleep restriction. The topical sleep diary was analyzed and a new sleep window for the following week was calculated. Patient and therapist discussed how helpful strategies could be maintained and how to prevent possible relapses.

1.4. Measurements

The measurements applied corresponded to propositions made by Buysse, Ancoli-Israel [36] and were complemented by assessments of pre-sleep arousal, maladaptive sleep-related cognitions and the perceived competence to deal with complaints. Treatment was evaluated after the diagnostic session (pre-test), after the last session (post-test) and two months after the last session (follow-up [FU]). Questionnaires, diaries, and actigraphic devices were handed out and re-collected during the week between the diagnostic session and the first intervention session, directly after the last session, and during the week before the FU. Additionally, pre-sleep arousal, maladaptive cognitions, and the perceived competence to deal with complaints were assessed before every session.

1.4.1. Primary sleep outcomes

The Pittsburgh Sleep Quality Index [PSQI; 41] in its German version covered two instead of the preceding four weeks [42] and was applied to assess changes in overall sleep quality. The PSQI sum score ranged from 0 (*no insomnia*) to 21 (*severe insomnia*) and included the components of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. A cut-off score of >6 was found to best distinguish between insomniac and healthy individuals in a German sample [42]; Cronbach's alpha in the current sample was 0.70.

1.4.2. Secondary sleep outcomes

Secondary sleep outcomes consisted of actigraphy results and sleep diaries. Sleep onset latency (SOL), total sleep time (TST), and sleep efficiency [SE = (TST/TIB) × 100] were calculated, while TIB refers to the time in bed. SOL, TST, and SE were measured daily and averaged across each week.

1.4.2.1. Actigraphic sleep quality. Actigraphic sleep quality was recorded using MotionWatch 8™ (CamNtech Ltd., Cambridge, United Kingdom), a tri-axial wrist-worn accelerometer (MEMS technology 0.01 g–8 g range, 3–11 Hz) and corresponding MotionWare software (CamNtech Ltd.). Actigraphic data were recommended whenever polysomnography was not feasible [36] and the current device corresponded with polysomnographic data regarding SOL, TST, and SE [43]. As recorded lights off and rising times were not saved dependably within the actigraphic data file, these specifications were taken from the sleep diaries.

1.4.2.2. Diary sleep quality. We utilized paper-and-pencil sleep versions of a diary suggested by the German Sleep Society [44].

1.4.3. Sleep-related outcomes

The sleep-related outcomes were aimed at covering daytime functioning and psychological strain. As recommended by Buysse et al. [36], they covered daytime fatigue, depression, anxiety, pre-sleep arousal, insomnia-specific worries, and the perceived competences to deal with the difficulties.

1.4.3.1. Daytime fatigue. The Fatigue Severity Scale [FSS; 45, German version: 46] is the gold standard used to assess daytime fatigue; it consists of nine items to be rated on a 7-point Likert scale, higher values indicating greater fatigue. Cronbach's alpha in the current sample was 0.94.

1.4.3.2. Depression & anxiety. The Center for Epidemiological Studies - Depression Scale [CES-D; 47, German version: 48] was used to assess depressive symptoms, as the questionnaire is recommended to assess depressive symptoms in the general population; Cronbach's alpha in the current sample was 0.94. The trait version of the State-Trait Anxiety Inventory [STAI-T; 49, German version: 50] was used to assess anxiety. Cronbach's alpha in the current sample was 0.96.

1.4.3.3. Pre-sleep arousal. The Pre-Sleep Arousal Scale [PSAS; 51, German version: 52] assessed cognitive (eg, being mentally alert, active) and somatic manifestations of arousal (eg, heart racing, pounding or beating irregularly) prior to falling asleep the previous night. Here, the 15-item version was used, and items were rated on a Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). Cronbach's alpha in the current sample was 0.92 for somatic and 0.96 for cognitive arousal.

1.4.3.4. Insomnia-specific worries. The Anxiety and Preoccupation about Sleep Questionnaire [APSQ; 53,54] was used to assess sleep-related worry and the effort individuals put in their attempt to fall asleep (eg, “I worry about my loss of control over sleep” and “My failure to rectify my sleep problems troubles me a lot”). Ten items were rated on a 10-point Likert scale that ranged from 1 (*not true*) to 10 (*very true*). Participants were required to rate how true each of the statements was over the past three days. The first author translated the questionnaire into the German language, and a native English-speaking psychologist retranslated the items back into English. The final version was created by mutual agreement; here, the sum score was used. Cronbach's alpha in the current sample was 0.97.

1.4.3.5. Perceived competences. The Perceived Competence Scale (PCS) was originally developed to assess students' ability to master challenges in order to pass an exam, but the authors explicitly stated the items could also be applied to other health-related problems, such as smoking cessation or diabetes care [55]. Here, the four items were reformulated to cover sleep problems (eg, “I feel confident in my ability to manage my sleep problems”). The 7-point Likert scale ranged from 1 (*not at all true*) to 7 (*very true*). A principal component factor analysis yielded one single factor that

explained 61% of the total variance. Cronbach's alpha in the current sample was 0.96.

1.4.4. Patients' perception of treatment

Visual analog scales ranging from 0 to 100% were presented to assess patients' perception of the treatment ("Did the treatment meet your expectations?"; "How helpful did you perceive the last session?", the latter question was asked just before the patients received the subsequent session; available data for these questions address the first and second session only).

All questionnaires and sleep diaries were administered in a written paper-and-pencil form to both groups before and after each session, at post-test, and follow-up (FU).

1.5. Statistical analyses

IBM SPSS statistics 24 was used for all analyses. Statistical treatment efficacy was tested using multilevel linear regression modeling (MLM) as these analyses allowed the inclusion of patients with incomplete data sets while still creating adequate estimates. Single items that patients left out while filling in the questionnaires were replaced by median substitution. Within-participants effects (immediate: pre vs. post; sustained: pre vs. FU), between-participants effects (group: FtF, chat-based; WL), and within-between interactions (time x group) were added to the model. Time effects were modeled using an autoregressive covariance structure, AR (1) heterogeneous, assuming that the covariation between the scores decreased over time.

Clinical treatment efficacy was evaluated using the PSQI sum score, actigraphic and diary SOL and SE, as there are cut-off values previously reported for all of these outcome measures: PSQI, > 6 [42], SOL, < 30 min [35,36], and SE, > 85% [40]. The proportion of participants in each group and the respective time point with clinically significant scores above the respective cutoff were counted and compared using χ^2 tests. Additionally, the reliable change index (RCI) was calculated for the PSQI sum score by dividing the difference between the pre-test and post-test score (and pre-test and FU score, respectively) by the standard error of difference. The formula of the standard error of difference was $SE_{diff} = \sqrt{2}*(SE_{meas})^2$, where SE_{meas} is the standard error of the measurement. The formula was $SE_{meas} = SD_{pre}*\sqrt{1-r_{11}}$, where SD was the standard deviation of the measurement and r_{11} the reliability of the measurement. An RCI >1.96 was considered a reliable change that was unlikely to occur by chance [56]. Statistical significance was set to $p < 0.05$ (two-sided) throughout the study.

To check for successful randomization, χ^2 tests for dichotomous variables and ANOVAs revealed that the three groups did not differ regarding demographic characteristics (see Table 1). However, wait-listed patients ($M = 18.05$, $SD = 7.42$) were more depressed than FtF patients ($M = 13.04$, $SD = 6.85$, $p = 0.033$), $F(2, 69) = 3.43$, $p = 0.038$, and wait-listed patients ($M = 2.45$, $SD = 0.54$) reported slightly higher state anxiety than FtF patients ($M = 2.14$, $SD = 0.42$, $p = 0.083$), $F(2, 69) = 3.16$, $p = 0.049$. To control for these differences, all MLMs were controlled for baseline depression and anxiety.

There were no significant differences between patients who finished the intervention and those who did not, all $\chi^2 < 4.05$, all $ps > 0.540$ and all $Fs < 2.05$, all $ps > 0.150$. Although slight differences in actigraphic TST could be found, these were not significant ($M_{Completer} = 381.50$, $SD = 39.91$; $M_{Dropout} = 420.18$, $SD = 53.35$), $F(1, 125) = 3.40$, $p = 0.070$.

Between-group effect sizes were calculated with Cohen's $d = (M_{1\_pre} - M_{1\_post}) - (M_{2\_pre} - M_{2\_post})/SD_{pooled}$ while $SD_{pooled} = \sqrt{[(SD_{1\_pre}{}^2 + SD_{2\_pre}{}^2)/2]}$ [57], and within-group effect sizes were calculated with Cohen's $d = (M_{pre} - M_{FU})/SD_{pooled}$ while $SD_{pooled} = \sqrt{[(SD_{1\_pre}{}^2 + SD_{2\_pre}{}^2)/2]}$ [57]. Assuming that data were missing at random, missing variables were imputed on the basis of 10 data sets.

Sample size was calculated a priori using G*Power [58]. In order to reveal a moderate time × group interaction effect ($f = 0.25$, $\alpha = 0.05$, $\beta = 0.95$), the estimated total sample size was $N = 54$ (ie, $n = 18$ per group). Given an expected attrition rate of 25%, an n of 23 completers (who finished treatment and FU) per group was pursued.

2. Results

2.1. Immediate treatment efficacy

Immediate treatment efficacy as assessed before and directly after treatment is presented in Table 2; clinical treatment efficacy is presented in Table 3.

2.1.1. Primary sleep outcomes

Compared to the waiting list control group, both FtF patients and chat patients improved in PSQI sleep quality ($d = 1.02$ and $d = 1.69$, respectively, both $ps \leq 0.001$). Even though effect sizes in the chat-based group were slightly higher, both groups did not differ significantly from each other (FtF vs. chat, $d = 0.47$, $p = 0.149$). The same pattern was observed regarding clinical significance. Almost twice as many patients in the chat-based group displayed changes of ≥2 standard deviations (RCI < −1.96, 62%) compared to FtF (35%), though this observation was not statistically significant, $\chi^2(1) = 3.24$, $p = 0.072$. Three FtF patients and one chat patient did not benefit from pre-test to post-test (FtF: RCI = 0.00, RCI = 1.19, RCI = 0.79; chat: RCI = 0.79).

2.1.2. Secondary sleep outcomes

Compared to the waiting list control group, both FtF patients and chat patients improved in actigraphic SOL, diary SOL, and diary SE (all $ds = 0.44$–1.12; all $ps \leq 0.017$). There were no changes regarding actigraphic SE (both $ds \leq -0.43$, both $ps \geq 0.077$). Regarding actigraphic TST, FtF patients displayed an unexpected and significant deterioration in actigraphic TST compared to the waiting list control group ($d = 0.71$, $p = 0.003$), while the chat-patients' actigraphic TST in did not change ($d = 0.06$, $p = 0.295$; FtF vs. chat, $d = 0.61$, $p = 0.090$). Patients in both groups did not improve regarding diary TST (both $ds \leq 0.06$, both $ps \geq 0.663$).

2.1.3. Sleep-related outcomes

Compared to the waiting list control group, both FtF patients and chat patients improved regarding daytime fatigue, cognitive pre-sleep arousal, insomnia-specific worries, and perceived competences in dealing with sleep difficulties (all $ds = 0.71$–1.30; all $ps \leq 0.028$). There were no significant improvements in somatic pre-sleep arousal (both $ds \leq 0.50$, both $ps \geq 0.081$). Decreases in depressive symptoms were slightly, but non-significantly higher in chat patients than in FtF patients ($d = -0.62$, $p = 0.054$). Regarding anxiety, chat patients improved ($d = 0.21$, $p = 0.031$), while FtF patients did not improve ($d = 0.01$, $p = 0.173$; FtF vs. chat, $d = 0.24$, $p = 0.357$).

2.2. Sustained treatment efficacy

Sustained treatment efficacy as assessed before treatment and at the two month follow-up are presented in Table 4; clinical treatment efficacy is presented in Table 3.

Table 1
Demographic characteristics of patients.

	Group				p
	FtF	Chat	WL		
	(n = 27)	(n = 23)	(n = 22)		
Gender					
Male	14 (52%)	10 (44%)	10 (47%)		
Female	13 (48%)	13 (56%)	12 (53%)	χ^2 (2) = 0.39	0.823
Age, years	39.30 (14.47)	39.74 (11.16)	42.74 (11.73)	F (2, 69) = 0.88	0.418
Occupation					
Employed	13 (48%)	16 (70%)	15 (68%)		
Self-employed	2 (7%)	4 (17%)	4 (18%)		
Apprenticeship	6 (22%)	2 (9%)	1 (5%)		
None	6 (22%)	1 (4%)	2 (9%)	χ^2 (6) = 9.39	0.153
Symptom duration, years	9.16 (10.17)	7.12 (5.61)	12.09 (10.52)	F (2, 67) = 1.38	0.259
Distinct trigger that caused symptoms					
Yes	9 (33%)	11 (48%)	11 (50%)		
No	18 (67%)	12 (52%)	11 (50%)	χ^2 (2) = 1.69	0.430
Shared bedroom					
Yes	11 (41%)	10 (44%)	12 (55%)		
No	11 (41%)	9 (39%)	8 (36%)		
Partly	5 (19%)	4 (17%)	2 (9%)	χ^2 (4) = 1.41	0.843
Sleep medication (prescribed)					
Yes	6 (22%)	4 (17%)	1 (5%)		
No	21 (78%)	19 (83%)	21 (96%)	χ^2 (2) = 3.04	0.218
Medication (other than for sleeping)					
Yes	6 (22%)	4 (17%)	5 (23%)		
No	21 (78%)	19 (83%)	17 (77%)	χ^2 (2) = 0.245	0.885
Former psychotherapy					
Yes	9 (33%)	12 (52%)	9 (41%)		
No	18 (67%)	11 (48%)	13 (59%)	χ^2 (2) = 1.82	0.402

Note. FtF, Face-to-Face; WL, waiting list control group; if not indicated differently, values in parentheses are standard deviations.

Table 2
Immediate treatment efficacy, mean (M), standard deviation (SD), and changes in Cohen's d as a function of treatment group (face-to-face [FtF], chat-based, waiting list control group [WL]) and time (pre, post).

	FtF				Chat				WL				Changes in Cohen's d					
	Pre		Post		Pre		Post		Pre		Post		FtF x WL		Chat x WL		FtF x Chat	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)	d	p	d	p	d	p
Primary sleep outcomes																		
PSQI sleep quality	11.41	(3.64)	7.65	(3.68)	12.00	(2.70)	6.76	(2.51)	11.41	(3.20)	11.17	(3.24)	1.02	0.001	1.69	<0.001	−0.46	0.149
Secondary sleep outcomes																		
Actigraphic SOL	15.09	(13.82)	8.00	(9.09)	16.70	(24.35)	8.92	(9.90)	10.76	(12.44)	18.73	(21.47)	0.93	0.013	0.71	0.017	−0.08	0.901
Diary SOL	38.16	(31.13)	20.49	(27.55)	38.22	(28.72)	15.84	(10.78)	27.42	(24.00)	37.19	(32.99)	0.91	0.004	1.12	<0.001	−0.18	0.617
Actigraphic TST	389.20	(42.39)	328.19	(55.18)	367.53	(42.33)	337.01	(46.70)	394.17	(36.26)	373.07	(41.46)	0.71	0.003	0.06	0.295	0.61	0.090
Diary TST	355.73	(86.54)	362.94	(84.66)	357.55	(50.40)	360.64	(46.93)	337.63	(84.26)	342.65	(92.09)	0.01	0.646	0.06	0.663	−0.05	0.541
Actigraphic SE	77.32	(6.93)	79.10	(7.88)	79.23	(7.30)	82.11	(5.18)	80.19	(4.83)	80.16	(6.08)	−0.34	0.396	−0.43	0.077	0.10	0.538
Diary SE	72.25	(15.07)	85.40	(13.84)	76.60	(9.94)	88.52	(5.44)	69.94	(17.39)	73.96	(17.21)	−0.46	0.001	−0.44	0.008	−0.08	0.541
Sleep-related outcomes																		
FSS daytime fatigue	4.35	(1.12)	3.72	(1.66)	4.63	(1.14)	3.95	(1.41)	4.63	(1.07)	4.78	(1.04)	0.72	0.028	0.75	0.003	−0.04	0.791
CES-D depression	13.04	(6.85)	10.61	(8.84)	15.13	(5.59)	8.86	(5.24)	18.05	(7.42)	18.39	(8.93)	0.39	0.047	1.01	<0.001	−0.62	0.054
STAI-T anxiety	2.14	(0.42)	2.09	(0.62)	2.15	(0.45)	1.99	(0.42)	2.45	(0.54)	2.39	(0.53)	0.01	0.173	0.21	0.031	−0.24	0.357
PSAS somatic arousal	11.59	(3.51)	9.39	(2.73)	12.83	(4.40)	9.62	(2.01)	13.24	(3.97)	12.11	(2.87)	0.29	0.204	0.50	0.081	−0.25	0.360
PSAS cognitive arousal	19.85	(6.55)	12.83	(7.01)	19.87	(5.27)	10.43	(2.68)	19.33	(6.11)	16.83	(5.68)	0.71	0.012	1.22	<0.001	−0.41	0.118
APSQ insomnia-specific worries	56.41	(19.04)	35.09	(19.71)	61.78	(15.96)	34.90	(16.12)	62.62	(16.69)	54.78	(21.51)	0.75	0.026	1.17	<0.001	−0.32	0.400
PCS perceived competences	3.35	(1.30)	4.97	(1.74)	3.79	(0.95)	5.15	(1.05)	3.15	(0.97)	3.28	(1.19)	−1.30	0.002	−1.29	0.001	−0.22	0.529

Note. PSQI, Pittsburgh Sleep Quality Index; SOL, sleep onset latency; TST, total sleep time; SE, sleep efficiency; FSS, Fatigue Severity Scale; CES-D, Center for Epidemiological Studies - Depression Scale; STAI-T, State-Trait-Anxiety Inventory-Trait version; PSAS, Pre-sleep Arousal Scale; APSQ, Anxiety, and Preoccupation about Sleep Questionnaire; PCS, Perceived Competence Scales. Statistics are based on multilevel regression analyses with baseline depression and anxiety as covariates. Missing values for Cohen's d were imputed by multiple imputations based on 10 data sets.

2.2.1. Primary sleep outcomes

Improvements of both FtF patients and chat patients in PSQI sleep quality remained from pre-test to FU (d = 1.18 and d = 2.40, respectively, both $ps \leq 0.001$). Although effect sizes in the chat-based group were slightly higher, both groups did not differ significantly from each other (FtF vs. chat, d = 0.47, p = 0.399). The same pattern was observed regarding clinical significance. More chat patients displayed sustained changes of $\geq$2 standard deviations (RCI < −1.96, 56% and 35%, for chat and FtF), although this observation was not statistically significant, χ^2 (1) = 1.62, p = 0.203. One FtF patient and the only chat patient who did not benefit from pre-test to post-test, improved at FU (RCI = −3.18, RCI = −0.40,

Table 3
Number (*n*) and proportion (%) of participants with clinical scores on major outcome measures for face-to-face (FtF), chat-based, and waiting list control group (WL) at pre-test, post-test and two-month follow-up (FU).

	Group	Pre	Post	FU	χ^2 (2)	*p*
		n (%)	*n* (%)	*n* (%)		
Primary sleep outcomes						
PSQI sleep quality, RCI < −1.96	FtF		15 (65%)	10 (56%)		
	Chat		8 (38%)	7 (35%)		
	WL		16 (89%)			
PSQI sleep quality > 6	FtF	25 (93%)	16 (70%)	7 (39%)	15.02	<0.001
	Chat	23 (100%)	9 (43%)	8 (40%)	21.58	<0.001
	WL	21 (95%)	16 (89%)		0.62	0.433
Secondary sleep outcomes						
Actigraphic SOL > 30 min	FtF	4 (18%)	0 (0%)	1 (6%)	4.22	0.121
	Chat	3 (14%)	2 (10%)	1 (6%)	0.63	0.729
	WL	1 (5%)	4 (25%)		3.39	0.066
Diary SOL > 30 min	FtF	10 (42%)	3 (15%)	3 (19%)	4.67	0.097
	Chat	12 (52%)	2 (10%)	1 (5%)	17.11	<0.001
	WL	7 (32%)	10 (53%)		1.82	0.177
Actigraphic SE < 85%	FtF	18 (82%)	14 (78%)	9 (56%)	3.37	0.185
	Chat	16 (76%)	14 (70%)	12 (75%)	0.22	0.895
	WL	19 (86%)	14 (88%)		0.01	0.919
Diary SE < 85%	FtF	22 (92%)	4 (20%)	6 (38%)	24.71	<0.001
	Chat	17 (74%)	4 (19%)	5 (24%)	17.16	<0.001
	WL	17 (77%)	12 (63%)		0.98	0.322

Note. PSQI, Pittsburgh Sleep Quality Index; SOL, sleep onset latency; SE, sleep efficiency; RCI, Reliable change index.

Table 4
Sustained treatment efficacy, mean (*M*), standard deviation (*SD*), and changes in Cohen's *d* as a function of treatment group (face-to-face [FtF], chat-based, waiting list control group [WL]) and time (pre, FU).

	FtF				Chat				Cohen's *d*				Changes in Cohen's *d*	
	Pre		FU		Pre		FU		FtF		Chat		FtF x Chat	
	M	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*d*	*p*	*d*	*p*	*d*	*p*
Primary sleep outcomes														
PSQI sleep quality	11.41	(3.64)	6.94	(3.90)	12.00	(2.70)	6.05	(2.24)	1.18	<0.001	2.40	<0.001	−0.47	0.399
Secondary sleep outcomes														
Actigraphic SOL	15.09	(13.82)	11.20	(21.77)	16.70	(24.35)	11.02	(11.18)	0.23	0.563	0.32	0.218	−0.14	0.739
Diary SOL	38.16	(31.13)	20.11	(17.77)	38.22	(28.72)	15.81	(10.86)	0.79	0.014	1.02	<0.001	−0.33	0.488
Actigraphic TST	389.20	(42.39)	355.15	(58.11)	367.53	(42.33)	359.01	(43.57)	0.78	0.041	0.27	0.426	0.54	0.238
Diary TST	355.73	(86.54)	374.80	(70.86)	357.55	(50.40)	397.46	(45.93)	−0.36	0.647	−0.82	<0.001	0.28	0.039
Actigraphic SE	77.32	(6.93)	80.46	(9.12)	79.23	(7.30)	81.98	(5.57)	−0.47	0.143	−0.43	0.145	−0.10	0.930
Diary SE	72.25	(15.07)	87.32	(10.13)	76.60	(9.94)	89.72	(6.21)	−1.32	<0.001	−1.58	<0.001	−0.31	0.782
Sleep-related outcomes														
FSS daytime fatigue	4.35	(1.12)	3.17	(1.54)	4.63	(1.14)	3.06	(1.32)	0.88	0.003	1.27	<0.001	−0.27	0.297
CES-D depression	13.04	(6.85)	10.50	(9.00)	15.13	(5.59)	7.75	(4.98)	0.32	0.141	1.39	<0.001	−0.67	0.028
STAI-T anxiety	2.14	(0.42)	2.00	(0.62)	2.15	(0.45)	1.88	(0.42)	0.27	0.183	0.63	0.002	−0.25	0.217
PSAS somatic arousal	11.59	(3.51)	10.33	(3.11)	12.83	(4.40)	10.10	(2.38)	0.38	0.042	0.77	0.010	−0.53	0.280
PSAS cognitive arousal	19.85	(6.55)	14.78	(7.46)	19.87	(5.27)	10.15	(2.96)	0.72	0.004	2.27	<0.001	−0.82	0.039
APSQ insomnia-specific worries	56.41	(19.04)	27.83	(19.12)	61.78	(15.96)	25.55	(12.06)	1.50	<0.001	2.56	<0.001	−0.48	0.299
PCS perceived competences	3.35	(1.30)	5.71	(1.46)	3.79	(0.95)	5.60	(0.99)	−1.71	<0.001	−1.86	<0.001	−0.44	0.238

Note. PSQI, Pittsburgh Sleep Quality Index; SOL, sleep onset latency; TST, total sleep time; SE, sleep efficiency; FSS, Fatigue Severity Scale; CES-D, Center for Epidemiological Studies - Depression Scale; STAI-T, State-Trait-Anxiety Inventory-Trait version; PSAS, Pre-sleep Arousal Scale; APSQ, Anxiety and Preoccupation about Sleep Questionnaire; PCS, Perceived Competence Scales. Statistics are based on multilevel regression analyses with baseline depression and anxiety as covariates. Missing values for Cohen's *d* were imputed by multiple imputations based on 10 data sets.

respectively), while two FtF patients still did not benefit at FU (RCI = 1.19, RCI = 0.79).

2.2.2. Secondary sleep outcomes

Improvements regarding diary SOL and diary SE remained from pre-test to FU (all $ds = 0.79–1.58$; all $ps \leq 0.014$). While changes in diary SOL remained, changes in actigraphic SOL that were found at post-test, disappeared at FU in both groups (both $ds \leq 0.32$, both $ps \geq 0.218$). Regarding the clinical significance of changes in diary SOL, there were no significant changes in the proportion of FtF patients that scored above the cut-off of SOL >30 min at pre-test, post-test, and FU, χ^2 (2) = 4.67, $p = 0.097$. However, a significant number of chat patients changed from a diary SOL above the cut-off of > 30 min to a diary SOL below the cut-off, χ^2 (2) = 17.11, $p < 0.001$. Clinical changes regarding diary SE (ie, changes from above a cut-off of SE < 85% to below the cut-off) were significant in both intervention groups, both χ^2 (2)s ≤ 17.16, both $ps < 0.001$, but not in the waiting list control group, χ^2 (2) = 0.98, $p = 322$. At FU, both interventions still did not affect actigraphic SE (both $ds \leq 0.47$, both $ps \geq 0.145$). Regarding actigraphic TST in FtF patients, the unexpected significant deterioration at post-test remained at FU ($d = 0.78$, $p = 0.041$), while actigraphic TST in chat patients still did not change ($d = 0.27$, $p = 0.426$). Regarding diary TST, chat patients finally improved from pre-test to FU ($d = −0.82$, $p < 0.001$), while

FtF patients still did not ($d = -0.36$, $p = 0.647$). Chat patients improved significantly more regarding diary TST than FtF patients ($d = 0.28$, $p < 0.039$).

2.2.3. Sleep-related outcomes

Improvements regarding daytime fatigue, cognitive pre-sleep arousal, insomnia-specific worries, and perceived competences in dealing with sleep difficulties remained from pre-test to FU (all $ds = 0.72–2.56$, all $ps \leq 0.004$). Improvements regarding somatic pre-sleep arousal finally became significant at FU for both groups (both $ds \geq 0.38$, both $ps \leq 0.042$). At FU, changes in depression that were found at post-test disappeared in FtF ($d = 0.32$, $p = 0.141$), but remained in chat patients ($d = 1.39$, $p < 0.001$). Chat patients improved more regarding symptoms of depression than FtF patients ($d = -0.67$, $p = 0.028$). Regarding anxiety, chat patients improved from pre-test to FU ($d = 0.63$, $p = 0.002$), while FtF patients did not ($d = 0.27$, $p = 0.183$; FtF vs. chat, $d = -0.25$, $p = 0.217$). Chat patients decreased more in cognitive pre-sleep arousal than FtF patients did ($d = -0.82$, $p = 0.039$).

2.3. The patients' perception

When asked whether the intervention met the patients' expectations, there was a main effect of time, indicating that treatment satisfaction increased from post-test ($M = 68.21$, $SD = 23.98$) to FU ($M = 79.71$, $SD = 21.51$), $F(1, 37.55) = 11.14$, $p = 0.002$, while there were no effects of group or of the interaction, $Fs < 0.50$, $ps > 0.500$, *n.s.*

When asked how helpful the patients perceived the previous session, a 2 (session: 1 vs. 2) x 2 (group: FtF vs. chat) MLM was calculated. The analysis yielded a main effect of session, indicating that treatment satisfaction increased from session 1 ($M = 48.55$, $SD = 28.82$) to session 2 ($M = 75.00$, $SD = 19.36$), $F(1, 38.94) = 17.79$, $p < 0.001$, as well as a significant interaction, $F(1, 28.91) = 5.47$, $p = 0.026$. Separate analyses with FtF patients only confirmed the main effect of session, $F(1, 19.42) = 24.14$, $p < 0.001$ ($M_{S1} = 42.53$, $SD = 29.87$ vs. $M_{S2} = 78.33$, $SD = 14.84$), while this effect was only marginally significant for chat patients, $F(1, 11.06) = 3.57$, $p = 0.086$.

3. Discussion

The current trial compared face-to-face and chat-based insomnia interventions including imagination, sleep hygiene, and sleep restriction with a waiting list control group. In overall sleep quality as the main outcome variable, both intervention groups improved compared to the waiting list control group ($d_{FtF} = 1.02$; $d_{Chat} = 1.69$), and compared to the pre-test, changes remained until FU ($d_{FtF} = 1.18$; $d_{chat} = 2.40$). Clinically reliable changes were found in 35% and 44% of the FtF patients, for both the post-test and the two-month FU, as well in 62% and 65% of the chat patients, while in the WL, 11% of all patients improved clinically. Two FtF patients did not benefit at all, and there was a tendency towards a higher proportion of chat patients that changed towards a normal sleep pattern.

Objective improvements (ie, actigraphic improvements in sleep onset latency, SOL) that were obtained at the post-test time point could not be maintained until FU. By contrast, subjective improvements (ie, diary-based improvements in SOL) remained until FU. There were significant improvements in subjective sleep efficiency (SE) in both groups, which could not be found objectively. Regarding the objectively assessed total sleep times (TST), FtF patients even declined in their TST, while chat patients' actigraphy TST did not change. Regarding diary TST, there were no improvements from pre-test to post-test in both groups, although chat patients improved in their TST from pre-test to FU, and they improved significantly more than FtF patients.

Regarding the sleep-related outcomes, chat patients only improved in their reported anxiety levels at the post-test time-point and FU, while FtF patients did not. Improvements in daytime fatigue, insomnia-specific worries, and the perceived competence to deal with the sleep difficulties could be found in both treatment groups and at both time points. Improvements in somatic arousal that did not become significant at the post-test level did become significant at FU. Chat patients improved more in depression and cognitive arousal than FtF patients.

Thus, a chat-based insomnia treatment can be delivered as effectively as an FtF and tends to be more efficacious. This is especially important against the background that chat-based interventions are one of the most frequently used methods of delivery in Internet-based interventions, though only a few trials have targeted its effects so far [29]. Effects sizes were comparable with those other interventions addressing insomnia [13] as well as with other Internet-based interventions [20]. The current outcomes were found even though the current intervention was rather short and consisted of only three sessions, while van Straten et al. [13], demonstrated that treatment efficacy was higher in trials that lasted for five or more sessions. At the same time, the results may be interpreted against the background that treatment outcomes generally improved since the 1990s [13].

Improvements in actigraphic SOL that were found at the post-test time point decreased at FU, while SOL as assessed by the sleep diary and assessments of overall sleep quality remained. Actigraphic TST even deteriorated in FtF patients, which contradicts other measures that were indicative of improved sleep quality. It also contradicts some previous findings [23] and provides support for other trials that also did not find any changes in diary TST [25]. Thus, the current findings may be interpreted as another hint for the importance of the subjective evaluation of one's sleep quality [cf 35,36,59].

If there were differences in outcome variables across both groups, they were always in favor of the chat-based group. This tendency seemed to increase over time and was manifested in subjective TST, depression, and cognitive pre-sleep arousal at FU. Objective TST deteriorated in the FtF group only, while the anxiety level improved only in the chat-based group. Thus, different outcomes between the FtF group and the chat-based group mainly affected outcomes beyond direct insomniac symptoms and addressed reductions in pre-sleep arousal, anxiety, and depression. These observations were not expected and appeared surprising as they rule out implicit common understanding that the Internet-based environment itself lowers treatment outcome, eg, by increasing arbitrariness while minimizing a sense of duty [60]. Effects could not be explained by distinct therapist factors, as all therapists conducted an equal number of both FtF treatments and chat-based treatments, and seemed to contradict Taylor, Peterson [24] as well as Lancee et al. [25], who demonstrated a superior performance of individual FtF therapy. Also, Blom, Tillgren [22] and de Bruin et al. [23], who did not find any differences between FtF treatment and Internet-based self-help, found that FtF was slightly more efficacious than the Internet-based intervention. Other work did not find any differences between FtF treatments and Internet-based treatments [21].

Here, a text-based Internet-based chat was applied, which is more comparable to a common individual FtF intervention than Internet-based self-help. In Internet-based self-help, therapeutic feedback differs substantially from FtF feedback as the former mainly contains reinforcing and self-efficacy shaping [26]. Besides, the content management system itself might have influenced treatment outcome in the Internet-based group [ie, by the web-

design, novelty, the quality of interactive tasks provided within the system, etc.; 27,28].

Differences between FtF and chat-based interventions target the absence of visual and auditory therapist cues, which might have stimulated feelings of autonomy and a sense of felt responsibility for treatment success. After treatment was finished, FtF patients stopped traveling in the outpatients' ambulance, an act that many of them perceived as stressful, while chat-patients' daily routines were less affected and fewer situations in their daily schedule changed after the treatment was finished. Besides, treatment outcome in Internet-based interventions depends more thoroughly on the patients' perceptions and processions [30], on the method of guidance by the therapist, and on the features provided by the Internet-based setting [27,28]. All those factors might also have supported treatment success. Increased privacy is another frequently discussed feature of text-based communication [31]. Chat-based patients were equally satisfied with both sessions, while FtF patients were less satisfied with session one that included the imagination exercise. This could be caused by the fact that the therapist was not visible for chat patients when they conducted the imagination task, and who might have facilitated more involvement in the exercise. Future research should help clarify how human and technical assistance can best support the patient and consequently enhance treatment success.

A number of limitations need to be addressed. Although the intervention can be assumed as efficacious, we strongly need to take into account that at least two patients did not benefit at all and that clinically relevant symptoms remained for about 40% of them. This is a known problem in insomnia treatment [cf 14,61]. Here, we tried to improve treatment efficacy by adding an imagination exercise to sleep restriction, the common gold standard. We note that FtF patients especially clearly favored the session that focused on sleep restriction, so much so that we cannot add to the literature by advising novel and improved treatment protocols. Perhaps such a resource-oriented imagination exercise should have been placed after patients were introduced to sleep restriction, but this remains to be tested. Statistical power was only sufficient to detect moderate treatment outcomes. Results on actigraphic and diary sleep parameters might have especially benefited from larger sample sizes. Furthermore, the applied strict exclusion criteria limit the generalizability of the current findings to other populations who seek treatment on their own accord without being recruited. Although comorbid mental disorders were accepted, the sample was community-based and may have consisted of individuals that were, despite their sleep complaints, rather healthy, well-educated, and well-integrated. Thus, they were provided with good resources to benefit from the intervention. Besides, longer follow up intervals would have allowed further control for the sustainability of the gained changes over longer periods. Finally, choosing an active control group that was also asked to keep sleep diaries instead of a waiting list control group might have improved the quality of the current trial. A major constraint of the trial was that blinding was not possible, given that both patients and therapists knew to which group the patients had been assigned. Although it was unknown to both patients and therapists whether they were assigned to a more efficacious group, an active control group would have helped to rule out suggestions that treatment effects were caused by expectancy effects.

Despite these limitations, the current trial demonstrated that a chat-based treatment for insomnia could be delivered as efficaciously as FtF treatment. As a text-based Internet chat is more comparable to a common FtF intervention than Internet-based self-help, it was striking that chat-based interventions even slightly outperformed the FtF intervention. This tendency increased from post-test to FU and became manifest for subjective TST, anxiety, depression, and cognitive pre-sleep arousal at FU. It might be caused by the fact that patients in chat-based treatment obtained highly individualized treatment, resulting in a more individualized treatment method than how patients are commonly treated during Internet-based self-help interventions. When weighing pros and cons, a major disadvantage of chatting was that writing took longer than talking, but it may also have helped to stick to the essence of which kind of information one wants to deliver. Further, chat-based communication may have reduced barriers and stimulated feelings of privacy, autonomy, and a sense of felt responsibility for treatment; this may have been what stimulated treatment success, although this hypothesis should be validated in future studies. To date, we can conclude that chat-based communication enables insomnia treatment for patients who either cannot or who do not want to visit FtF psychotherapists in their practices.

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Conflict of interest

There are no competing interests to declare.

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