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Research paper

Sleep disorders in patients with depression or schizophrenia: A randomized controlled trial using acupuncture treatment

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ABSTRACT

Introduction: The purpose of this preliminary clinical trial was to investigate whether acupuncture has a positive influence on sleep and symptomatology in patients with schizophrenia or depression.
Methods: A randomized controlled trial was conducted. One hundred participants were recruited: 40 outpatients with schizophrenia, 40 with depression, and 20 healthy controls. All completed a depression inventory, and the positive and negative symptoms of the patients with schizophrenia were evaluated by their psychiatrists. All participants were asked to complete a sleep log for two weeks. For the psychiatric patients, a randomized design with experimental (three months of acupuncture treatment) and control (waitlist) conditions was used, after which all measurements were conducted once more.
Results: Before treatment, patients with depression were awake longer during the night, needed more time to fall asleep, evaluated their sleep as less relaxed, felt more exhausted, and reported a lower average performance level compared with healthy controls. Moreover, patients with depression slept less and felt more exhausted than patients with schizophrenia. Patients with schizophrenia reported a lower average performance level compared to healthy controls. Acupuncture slightly improved sleep and depressive symptoms in patients with depression, but did not affect sleep nor influence positive and negative symptoms in patients with schizophrenia.
Conclusion: These preliminary data suggest that acupuncture can be used in order to reduce symptoms and improve sleep to some extent in patients with depression, but due to the lack of comparative data, it is impossible to reliably say anything about its effects for patients with schizophrenia.

1. Introduction

Epidemiological studies show that approximately 40 million people in the USA suffer from sleep disorders [1] and that 20% to 35% of the population show symptoms that are related to insomnia [2–4]; moreover, 57% of patients with insomnia have a psychiatric disorder or develop one within the next year [2]. A large European study found that 7% of the Europeans suffered from insomnia and 6.9% from depression, and more than 33% of the Europeans suffered from mental disorders [5]. Previous research revealed that insomnia and nightmares are important predictors of depressive symptoms [6,7], and depressive symptoms are risk factors for insomnia [8]; therefore, the relation between depression and sleep disorders seems to be bidirectional [9–11].

Sleep disorders are found in 30 to 80% of patients with schizophrenia [12] and in more than 80% of the patients with depression [13]. Moreover, problems with sleep are among the complaints that occur most often before a patient has a recurrent episode [14–18]. In their longitudinal study, Sands and Harrow [19] found that about one-third of the patients with schizophrenia suffered from depression, and a depression that was neither recognized nor treated could cause sleep disorders [20].

Compared to healthy controls, patients with schizophrenia were found to have a larger sleep latency in combination with a decreased total sleep time, decreased sleep efficiency, less time in phase-3 and −4 sleep (deep sleep), and longer REM sleep latency [21]. Indications suggest that in patients with schizophrenia,

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decreased sleep efficiency may be caused by longer sleep latency and an increased number of awakenings during the night [22].

Sleep disorders, especially in vulnerable patients with depression as well as those with schizophrenia, should be treated due to the beneficial overall influence of good sleep [23]. This is not only relevant for these patients, but also for society, because an improvement in sleep is estimated to lead to lower costs; yearly costs for insomnia for the USA alone are estimated to be $30 to $35 billion [24].

Different methods exist for the treatment of sleep disorders [25]. Traditionally, pharmacological interventions are used [26]. Benzodiazepines have traditionally been prescribed for sleep and still are. However, due to their high risk of tolerance and addiction, they have given way to a new group of hypnotics including zolpidem, zaleplon, and eszopiclone [27]. Psychological treatments such as stimulus control therapy, relaxation, paradoxical intention, sleep restriction, and cognitive-behavior therapy are used with success where available [28]. One relatively new method in non-Asian countries for the treatment of sleep disorders is the use of acupuncture as a non-pharmacological intervention technique because evidence exists that it may have beneficial effects as a treatment for insomnia [29–31].

The aim of this study was to investigate whether acupuncture has a positive influence on sleep in patients with schizophrenia and patients with depression. Before treatment (at baseline), we expected that patients with depression and patients with schizophrenia would sleep worse than the healthy controls and that, in line with the literature, the patients with depression would have the worst sleep of the three groups. Our hypothesis was that acupuncture would have a beneficial effect on sleep in patients with depression and in patients with schizophrenia and that typical symptoms would decrease.

2. Methods

2.1. Design overview

The study design included three groups: 1. an experimental intervention group of people with either schizophrenia or depression who received individualised acupuncture treatment once a week for a period of three months; 2. a waitlist control group of people with the same diagnosis; and 3. a healthy control group who were assessed to establish reference values for the current cultural and geographical cohort at baseline only.

The study was approved by the local ethics committee (Ärztekammer Nordrhein, trial number: 2008331)); and the clinical trial was officially registered under number NTR3132 at the Dutch Trial Register (see also http://www.trialregister.nl/trialreg/admin/rctview.asp?TC=3132). The study was conducted in accordance to the Declaration of Helsinki (http://www.wma.net/en/30publications/10policies/b3/). All participants in the study took part voluntarily without any inducement and could leave the study if they wished to at any time during the trial.

The healthy control participants, the patients with schizophrenia, and the patients with depression were asked to complete a sleep log for two weeks in order to establish a baseline (T1) measurement. The healthy control group was not treated with acupuncture; while no clinical effect of acupuncture could be expected in healthy participants (previous research has shown that acupuncture has a modulating and normalising effect) [32,33], they were only included to establish reference values in the current cultural and geographical cohort and were only used in the tests at T1. In the patient groups, two measurements were taken: before (T1) and after acupuncture treatment or a waitlist period (T2). Participants were required to complete a sleep log every morning

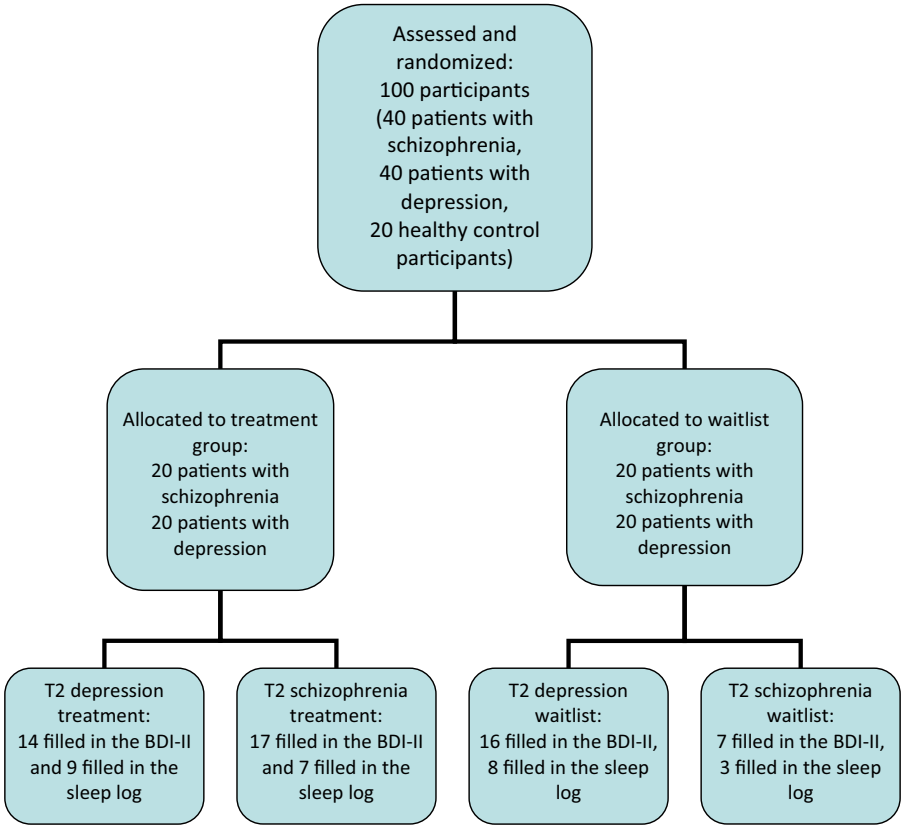

Fig. 1. CONSORT flow diagram. Note that patients felt that too much effort was required to fill in the sleep log every day, which is why they did not return the sleep log. Moreover, many could not be motivated to come to the after-test appointment.

just after waking and evening before going to sleep [34] (Fig. 1). This took approximately 10 min a day. Previous research showed that the sleep log was a reliable instrument for registering sleep in patients; in a study by Rogers, Caruso, and Aldrich [35], for instance, subjective data taken from sleep logs was found to be comparable to data from polysomnography (kappa = 0.87). Moreover, the sensitivity and the specificity of the sleep logs in this study [35] were found to be 92.3% and 95.6%, respectively. In addition to the sleep log, both the patients with depression and the patients with schizophrenia filled in a typical clinical instrument, namely, the Becks Depression Inventory-II (BDI-II) [36], to assess depression before and after the treatment or the waitlist period. The severity of the schizophrenia symptoms was assessed using the Positive and Negative Symptom Scale (PANSS) [37], which was filled in by each patient's psychiatrist before and after the treatment or the waitlist period of three months. The current study was approved by the local ethics committee (Ärztekammer Nordrhein, trial number: 2008331).

2.1.1. Outcome sleep logs

The primary outcome measures in this study were the scores on the following six sleep variables of the sleep log at T1: 1. "*Total sleep time*", 2. "*How many minutes awake during the night?*", 3. "*How many minutes awake before falling asleep*?" 4. "*How relaxing was your sleep?*", 5. "*Did you feel exhausted?*", and 6. "*How was your average performance level today?*" (Note that the first three sleep variables are the more "objective" ones and that the last three sleep variables are the more "subjective" ones.) The secondary outcome measures in our study were the difference in scores (between "before" (T1) and "after treatment/waitlist" (T2)) for the same six sleep variables.

2.1.2. Outcome clinical tests

Further outcome measures were the scores on the BDI-II at baseline and the differences on the BDI-II between T1 and T2 within the groups. Further outcome measures included the PANSS subscales (PANSSPOS, measuring the positive symptoms, PANSSNEG, measuring the negative symptoms, PANSSPSYCHO measuring general psychopathology and PANSSTOT measuring the total score of the PANSS) at T1, as well as the differences within the groups between the scores at T1 and T2.

2.2. Setting and participants

The inclusion criteria for participants were that they should have a diagnosis of either depression or schizophrenia, between 18 and 65 years of age, and regular attenders at a psychiatric outpatients department in Germany. Both the patients and the healthy control participants were recruited via posters in the clinic. In total, 100 participants were enrolled in this study: 40 patients with schizophrenia, 40 patients with depression, and 20 healthy controls. There were 22 female and 18 male adult patients with schizophrenia (average age = 42.20, standard deviation (*SD*) = 10.11 years), there were 33 female and 7 male adult patients with depression (average age = 48.37, *SD* = 8.88 years), and there were 11 female and 9 male adult healthy controls (average age = 33.05, *SD* = 11.27 years). Exclusion criteria included co-morbid diagnosis of epilepsy, substance abuse, and/or other neurological disorders. For the healthy control participants, the exclusion criteria were the presence of any neurological or psychiatric disorder or substance abuse. All participants of our study took part voluntarily without any inducement.

2.3. Randomization and intervention

Participants were randomly divided into an experimental or a control group. The random number generator program in Microsoft Excel was used for the randomisation [38]. In the experimental group, acupuncture treatment was given as intervention to the participant once a week. In total twelve treatments were given, each lasting one hour after needle insertion (note that, like Ronan and colleagues [39], a longer one hour treatment duration was chosen instead of the more common 20–30 min acupuncture treatment [40] to keep as close as possible to the standard protocol of the other treatments in the clinic, as was requested by the local ethics committee and by the clinic in order to get approval for treating particularly the vulnerable schizophrenia group with acupuncture). In the control group, the participants were on a waitlist and only received their regular care; no extra interventions were offered until the study was complete. At this point, these participants were offered twelve acupuncture treatments on a weekly basis in order to give them equal treatment opportunities as the patients in the experimental condition.

2.3.1. Acupuncture as clinical intervention

Individualised acupuncture was administered after careful individual diagnosis by a licensed Oriental medical practitioner with more than 5 years of clinical experience [41]. There were two acupuncturists involved in the present study and the delivery was such that all patients were treated 50% of the time by one acupuncturist and 50% of the time by the other acupuncturist. This was the case because we wanted to control for possible unrelated personal acupuncturist practitioner effects. The single-use needles (AcuPro C, Wujiang City Cloud & Dragon Medical Device Co., Ltd., China) for the acupuncture treatment were 0.25×25 mm or 0.20×15 mm stainless-steel needles, depending on the location on the body. The range of the absolute number of needles used (e.g., for all 12 acupuncture treatments taken together) was between 53 needles and 177 needles per individual. For both the individualised acupuncture, as well as for the individual clinical diagnosis, the principles of Traditional Chinese Medicine (TCM) were followed; the licensed Oriental medical practitioner described the disharmonies in terms of the Eight Fundamental Patterns: Interior, Exterior; Heat, Cold; Excess, Deficiency; Yin, Yang [42]. Finally, of the 20 patients in the depression experimental group (i.e., acupuncture treatment), 15 patients (75%) attended all 12 treatment sessions, while of the 20 patients in the schizophrenia experimental group (i.e., acupuncture treatment), 17 patients (85%) attended all 12 treatment sessions.

2.4. Data analyses

As a result of the large drop-out of participants, mostly lost during the waitlist period for the schizophrenia group, differences between the two psychiatric groups for the six sleep variables before (baseline = T1) and after acupuncture treatment (T2) were analyzed separately. Moreover, at T1 a healthy control group was included.

At T1, the scores for the six sleep variables from the sleep log were analyzed with a one-way analysis of variance (ANOVA) by using SPSS version 22.0 (IBM Corp., 2013) to indicate whether the three groups differed significantly across the different sleep variables. The dependent variables were the scores for the sleep variables and the between-subjects factor was the group (depression, schizophrenia, or healthy control group). A significance level of $P < 0.05$ was used.

The BDI-II data were more complete, and a sufficient number of participants were present at T1 and T2 for meaningful statistical analyses (although the number of subjects with schizophrenia on the waitlist was only seven). First, data at T1 were analyzed with an ANOVA with groups (depression waitlist, depression treatment, schizophrenia waitlist, schizophrenia treatment) as between-

subjects factor, followed by post-hoc tests. Next differences between T1 and T2 were established for all groups by using paired sampled Student *t*-tests. The PANSS data were only collected for the patients with schizophrenia, and the differences between T1 and T2 were analyzed by using GLM repeated measures. Only significant group differences are reported.

3. Results

3.1. Sleep log results at baseline

As seen in Table 1, the ANOVA showed a significant group effect ($F_{(2,59)} = 4.03$, $P < 0.05$, $eta^2 = 0.120$) on the "*Total sleep time*": patients with depression slept less than patients with schizophrenia ($P < 0.01$). The analyses of the "*How many minutes awake during the night?*" ($F_{(2,58)} = 7.54$, $P = 0.001$, $eta^2 = 0.206$) and of "*How many minutes awake before falling sleep?*" ($F_{(2,59)} = 3.48$, $P < 0.05$, $eta^2 = 0.105$) showed a group effect. In both cases, the patients with depression were awake longer than the healthy controls (*P*'s < 0.05). The more subjective sleep results (see also Table 1), where the participants had to indicate how they evaluated their sleep, also showed differences between the three groups. Significant group effects ($F_{(2,62)} = 4.59$, $P < 0.05$, $eta^2 = 0.129$) were found for "*How relaxing was your sleep?*" and "*Did you feel exhausted?*" ($F_{(2,62)} = 6.60$, $P < 0.01$, $eta^2 = 0.175$) and for "*How was your average performance level today?*" ($F_{(2,63)} = 14.05$, $P < 0.000$, $eta^2 = 0.308$). The patients with depression evaluated their sleep as less relaxing and were more exhausted compared to the patients with schizophrenia and the healthy control participants (*P*'s < 0.05). Both patient groups indicated their average performance level as worse (*P*'s < 0.01) compared to the healthy control participants. Moreover, the patients with depression evaluated their average performance level as being worse than that of the patients with schizophrenia ($P < 0.01$).

3.2. Clinical tests at baseline

The ANOVA of the BDI-II scores showed a significant group effect ($F_{(3,73)} = 5.82$, $P < 0.001$, $eta^2 = 0.19$), and post-hoc tests showed that the two groups with depression obviously scored higher than the two schizophrenia subgroups. The PANSS scores were only measured for the patients with schizophrenia and were not different between the treatment and the waitlist subgroups. All BDI-II and PANSS scores at T1 and T2 can be found in Table 2.

Table 1
Overview of the sleep log results at baseline (T1) for the depression group, the schizophrenia group, and the control group.

Sleep variable	Depression	Schizophrenia	Control
	(N[a] = 28)	(N = 20)	(N = 18)
How long have you slept?[b]	7.17 (0.83)*	7.98 (1.25)	7.43 (0.64)
How long (min.) were you awake during the night?	20.52 (21.05)**	11.88 (9.35)	3.16 (3.64)
How long did it take before falling asleep?[c]	30.29 (19.70)**	26.17 (25.19)	14.31 (11.30)
How relaxing was your sleep?[d]	3.28 (1.84)*,**	2.37 (0.72)	2.23 (0.55)
Have you felt exhausted?[e]	1.39 (0.56)*,**	0.92 (0.75)	0.77 (0.44)
How was your average achievement today?[f]	3.15 (0.55)*,**	2.67 (0.88)**	2.08 (0.56)

* Average score is significantly different ($P < 0.05$) from the average score for the group with schizophrenia.
** Average score is significantly different ($P < 0.05$) from the average score for the control group.
[a] N = number of participants.
[b] In hours.
[c] In minutes.
[d] On a 5 point scale (1 = very relaxing; 5 = not at all relaxing).
[e] On a 4 point scale (0 = no; 3 = very).
[f] On a 6 point scale (1 = good; 6 = bad).

3.3. Sleep log acupuncture effects

The schizophrenia waitlist group was no longer motivated to fill out the sleep log after the waitlist period: most patients reported that it was too much of an effort to think of the sleep log twice a day for two weeks. In this group, only three persons returned the form; therefore, this group was not included in the statistics at T2. Table 3 provides the ANOVAs the six sleep variables ("After acupuncture" – "After waitlist") for the remaining three groups (schizophrenia treatment group, depression treatment group and depression waitlist group) revealed a significant treatment effect on *"How relaxing was your sleep?"* ($F_{(2,21)} = 3.951$, $P < 0.05$, $eta^2 = 0.273$) and on *"Did you feel exhausted?"* ($F_{(2,21)} = 1256$, $P < 0.05$, $eta^2 = 0.274$). Post-hoc analyses revealed that both acupuncture groups evaluated their sleep as more relaxed than the waitlist group (*P*'s < 0.05) and that the group with schizophrenia was less exhausted than the waitlist group ($P < 0.05$). On the variable "*How many minutes awake before falling asleep?*" there was a trend towards the schizophrenia acupuncture group tending to be awake for less time than the waitlist group ($P = 0.07$) ($F_{(2,20)} = 2.996$, $P = 0.07$, $eta^2 = 0.231$). Differences within the groups between T1 and T2 were analyzed, but no significant differences were found, possibly partly due to large data loss related to the dropout because of the reluctance to complete the sleep log.

3.4. Acupuncture effects on the clinical tests

The paired samples *t*-tests showed a significant lower BDI-II score on T2 (compared to T1) for the depression treatment group ($t(14) = 3.48$, $P < 0.01$) only. Neither the PANSS subscales nor the PANSS total score showed any within-group or between-group effects.

4. Discussion

The aim of this study was to investigate whether acupuncture has a positive influence on sleep in patients with schizophrenia or depression. The hypotheses were that at baseline, patients with depression or schizophrenia would have worse quality of sleep than the healthy controls, that the patients with depression would have the worst sleep of the three groups, and that acupuncture would have a beneficial effect on sleep, depressive symptoms, and on positive and negative symptoms of schizophrenia.

At baseline, the sleep log results of the present study (see also Table 1) showed that, as was expected based on previous reports [12,13,43], the patients with depression reported more sleep problems than the patients with schizophrenia and the healthy control participants. This pattern was visible in both the more objective sleep measures, the shorter length of sleep, the longer period of lying awake during the night and the longer sleep latency, and the more subjective sleep measures on which participants with depression evaluated their sleep, i.e., being less relaxed, feeling more tired, and functioning less well during the day. Patients with depression slept just as long as the healthy controls, but showed worse results on all other variables. In addition, they felt more exhausted and slept for less time than the patients in the schizophrenia group.

In contrast to previous research [44–46] and therefore against our hypothesis, the patients with schizophrenia evaluated their sleep as being rather similar to that of the healthy control participants. The only exception was that they evaluated their average performance level of the day as worse than that of the healthy control group. The fact that patients with chronic

Table 2
Overview of the BDI-II at baseline (T1) and after treatment or after waitlist (T2) for the depression waitlist group, the depression treatment group, the schizophrenia waitlist group and the schizophrenia treatment group. Overview of the PANSS POS, PANSS NEG, PANSS PSYCHO, and the PANSS TOT scores at baseline (T1) and after treatment or after waitlist (T2) for the schizophrenia waitlist and the schizophrenia treatment groups.

Variable	Depression Group				Schizophrenia Group			
	WL[d] T1	WL[d] T2	TR[e] T1	TR[e] T2	WL[d] T1	WL[d] T2	TR[e] T1	TR[e] T2
BDI-II	24.83 *(12.12)*[c,f] (N[g] = 18)	22.19 *(11.46)*[c] (N = 16)	24.72 *(10.77)*[c] (N = 18)	15.53 *(10.97)* (N = 15)	14.00 *(10.52)* (N = 19)	10.29 *(11.76)* (N = 7)	13.25 *(10.43)* (N = 20)	12.81 *(7.65)* (N = 16)
PANSS POS	NA	NA	NA	NA	15.07 *(7.55)* (N = 14)	13.38 *(6.46)* (N = 8)	12.56 *(4.77)* (N = 18)	12.35 *(4.83)* (N = 17)
PANSS NEG	NA	NA	NA	NA	17.14 *(5.59)* (N = 14)	17.38 *(4.66)* (N = 8)	21.50 *(10.96)* (N = 18)	20.00 *(10.34)* (N = 17)
PANSS PSYCHO	NA	NA	NA	NA	39.64 *(12.20)* (N = 14)	37.50 *(10.66)* (N = 8)	40.50 *(14.65)* (N = 18)	37.47 *(12.23)* (N = 17)
PANSS TOT	NA	NA	NA	NA	71.93 *(19.52)* (N = 14)	68.50 *(18.74)* (N = 8)	74.56 *(27.65)* (N = 18)	69.82 *(25.30)* (N = 17)

NA = not applicable.
[a]Significantly different from the depression treatment group.
[b]Significantly different from the schizophrenia treatment group.
[c] Significantly different from the total schizophrenia group.
[d] WL = waitlist condition.
[e] TR = treatment condition.
[f] Standard deviation.
[g] N = number of participants.

Table 3
Overview of the sleep log results after acupuncture treatment versus after waitlist for the depression treatment group (N = 10), the depression waitlist group (N = 8) and the schizophrenia treatment group (N = 6).

Sleep variable	After Acupuncture		After Waitlist
	Depression *(N[a] = 10)*	Schizophrenia *(N = 6)*	Depression *(N = 8)*
Total sleep time?[b]	7.11 (0.72)	7.90 (0.90)	7.28 (1.52)
How many minutes awake during the night?	11.65 (10.60)	3.36 (4.68)	33.63 (72.96)
How many minutes awake before falling asleep?[c]	24.93 (16.38)	13.59 (7.41)	34.69 (19.58)
How relaxing was your sleep?[d]	2.47 (0.17)[*]	2.37 (0.22)[*]	3.08 (0.19)
Did you feel exhausted?[e]	1.19 (0.48)	0.72 (0.70)	1.57 (0.55)
How was your average performance level today?[f]	3.135 (0.82)	2.99 (9.14)	3.29 (0.68)

[**]Mean score is significantly different ($P < 0.05$) from the mean score for the schizophrenia group after acupuncture treatment.
[*] Mean score is significantly different ($P < 0.05$) from the mean score for the depression waitlist group.
[a] N = number of participants.
[b] In hours.
[c] In minutes.
[d] On a 5 point scale (1 = very relaxing; 5 = not at all).
[e] On a 4 point scale (0 = not; 3 = very).
[f] On a 6 point scale (1 = good; 6 = bad).

schizophrenia scored more in the normal range than one might expect is in line with a recent clinical study on personality and psychopathology in patients with long-term schizophrenia, who showed relatively few deviations from the healthy control group [47].

With respect to the possible acupuncture effect on sleep, a second main finding of this study was that the depression and the schizophrenia treatment groups evaluated their sleep at T2 as being more relaxed than that of the waitlist group while the evaluations of the two treatment groups did not differ. Furthermore, the individuals with schizophrenia felt less exhausted than the patients with depression in the waitlist subgroup at T2. Acupuncture had a positive effect on these two subjective variables, confirming the findings by Spence and colleagues that acupuncture seems to have a relaxing effect on patients with psychiatric problems [48]. This was also confirmed by the patients, who generally reported to benefit from the treatment, i.e., they felt fitter during the day, slept better, and reported to be happier compared to before the treatment started. In addition, for a more objective variable, a tendency towards acupuncture having a positive effect was found: The individuals with schizophrenia tended to lie awake for a shorter time than the waitlist group that had not received any additional treatment whereas the times lying awake for both depression groups were not different. No beneficial effects of acupuncture were found for the other two objective variables (the total sleep time and the number of minutes being awake during the night) or for the third subjective variable (the average performance level) (see Table 3). These results are partly in line with the results by Reshef and colleagues [30,31], who found no significant improvements on questionnaires that patients had to complete, but did find improvements on an actiwatch (which is an instrument to collect behavioral data on specific sleep parameters such as “sleep efficiency”, “sleep latency”, “absolute actual sleep time”, etc.) data for their patients with schizophrenia.

However, note that the results of the sleep log data at T2 should have been analyzed together with their T1 counterparts by using General Linear Model (GLM) repeated measures or difference scores in order to compare the results of the two psychiatric groups for the six sleep variables before (T1) and after acupuncture treatment (T2). Due to the large drop-out, especially in the

schizophrenia waitlist group, the scores for the sleep variables were analyzed with a one way ANOVA for three groups: depression treatment, depression waitlist, schizophrenia treatment groups.

With respect to the clinical symptoms, at baseline, the groups with depression had the expected elevated BDI-II scores, often in the clinical range, and did not differ from each other. The groups with schizophrenia naturally scored as being less depressed and did not differ from each other at baseline [36]. In general, the patients with depression scored in the range 20–28, indicating moderate depression, while the patients with schizophrenia scored in the range 14–19, indicating mild depression [49].

The PANSS [37] scores were only assessed for the patients with schizophrenia and were not different between the treatment and the waitlist subgroups (see also Table 2). In general, the PANSS scores showed that the patients were suffering from mildly to moderately severe positive and negative symptoms (the cut-off PANSS TOTAL score is 75 for moderate symptoms, with a lower score indicating symptoms that are less severe) [50].

With respect to the possible acupuncture effect on clinical symptoms, the depression acupuncture group improved significantly more on the BDI-II [36] than the depression waitlist group at T2 and differed significantly from its own score at T1, indicating a positive effect of the acupuncture treatment. The schizophrenia groups did not differ from each other, and no differences within and between the schizophrenia treatment and waitlist groups were found on the PANSS [37] on T2.

In summary, acupuncture treatment was found to improve the depressive symptoms of the patients with depression but not the symptoms of the patients with schizophrenia. The depression treatment group moved from “moderate depression” to “mild depression”, and these clinically- relevant treatment effects were also visible on an individual level, showing that patients moved from one clinical cut-off score to another (for instance, from “moderate depression” to “mild depression”). Moreover, acupuncture did not have a beneficial effect on the positive and the negative symptoms in patients with schizophrenia (see Table 2). This might be explained by their relatively low scores at T1 (mildly to moderately severe, even below the cut-off PANSS TOT score of 75) [50]. The supposed normalising effect of acupuncture would cause more differences in patients that show more severe scores than in those that show only mild scores. The relatively low scores in positive and negative symptoms at T1 (and T2) seem to indicate the comparative wellness of the cohort studied [51] and as a result, one would expect to see less evidence of a reduction in the scores and improvements might be more difficult to detect [52]. Previous research has shed some doubts on the sensitivity of the PANSS in this chronic patient group in research with acupuncture [32,50,51]. Secondly, as can also be seen in Table 2, the absolute scores on the PANSS subscales (with the exception of the PANSS POS subscale) do decrease between 1.5 and 4.7 points after acupuncture treatment; however, in future research larger clinical samples are needed in order to reliably test for significance since there is not enough statistical power in the present study.

Naturally, the present study has several limitations. In line with previous clinical acupuncture studies [53,54], as well as previous clinical studies on depression [55] and schizophrenia [56], a design with an experimental (three months of acupuncture treatment) and a control (waitlist) group was chosen. Unfortunately, during our study, most participants in the waitlist subgroup of the schizophrenia group dropped out. Participants turned out not to be willing to wait for three months before filling out the same forms again, even though they would have been allowed to receive acupuncture treatment after the second test period. Of the 40 participants in the total waitlist group, 29 (73%) participants were lost for the sleep log data, the dropout rate being greater for the patients with schizophrenia (85%) than for the patients with depression (60%). Especially, the patients with schizophrenia felt that too much effort was required to fill in the sleep log every day. This is further supported by the fact that a much higher percentage (60% in total) of the patients with schizophrenia could be motivated to fill in the BDI-II [36], more than twice as many as those who could be motivated to fill in the sleep log (25%) [34]. It would have been better to have used a less time-consuming sleep questionnaire, such as the Pittsburgh Sleep Quality Inventory (PSQI) [57] or the Epworth Sleepiness Scale [58], or even better to have used actiwatches [59] because actiwatches provide an opportunity to collect objective sleep quality data [59] from patients with depression and patients with schizophrenia without any significant daily effort.

Another limitation of our study is that although the participants were instructed to keep contemporary sleep logs, it is unknown whether participants carefully followed this instruction (i.e., kept contemporary or retrospective sleep logs) and this may have affected the outcomes. A solution to this problem seems to be the inclusion of a study nurse in future studies who will contact all participants on a daily basis and remember them of the exact study instructions.

All patients continued their medication during the study. For ethical reasons [60], stopping the treatment of psychiatric patients with antipsychotic and antidepressant drugs was not possible. In addition, because the participants in the present study used a wide variety of medications, better control of the type and the doses of the medications was impossible.

Finally, the sample sizes in the present psychiatric study are relatively small [61]. For practical reasons [62], the recruitment of more patients with schizophrenia and more patients with depression at our clinic was not possible. This is a common problem in clinical research, particularly in psychiatry, as well as acupuncture [63]. In future research, a multicenter study [64–67] seems to be an interesting alternative not only to increase the sample size but also to exclude effects of practitioner bias and the experimental/clinical atmosphere [66].

5. Conclusions

The present preliminary clinical data suggest that acupuncture seems to be a safe and useful non-pharmacological clinical intervention technique for improving sleep to some extent in patients with depression, and possibly in patients with schizophrenia. Acupuncture treatment was found to improve the depressive symptoms of the patients with depression, but as a result of a lack of comparative data, it is impossible to reliably say anything about its effects on the positive and the negative symptoms in the patients with schizophrenia, because the non-significant results found in the present study may be a reflection of the high rate of withdrawal in the waiting list group and the relative wellness of those included in the study. The question of whether the anti-depressive effects in the group with depression are caused by their improved quality of sleep or whether the improved quality of sleep is caused by the alleviation of the depressive symptoms cannot be answered with the present data because of the cause-and-effect problem resulting from the bidirectional associations between sleep and depression that has been reported in the literature [68]. Further and more extensive research using more objective sleep measurements and more extensive scales for depression might be able to answer this question. All in all, these data justify further research into the possible use of acupuncture in the treatment of depression and to a lesser degree, in the treatment of schizophrenia. In those future studies, it is particularly important to include patients with schizophrenia with high starting scores on the positive and negative symptoms in order to reliably test for possible

acupuncture treatment effects, because if one is already successfully treated then it is more difficult to statistically assess any beneficial effect that acupuncture may have. Moreover, in future research, it would be interesting to use a higher frequency and number of acupuncture treatments per week in treating patients with depression or schizophrenia in order to better test for possible acupuncture treatment effects.

Conflict of interest

The authors declare that there is no conflict of interests.

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