

# Music to improve sleep quality in adults with depression related insomnia (MUSTAFI): Study protocol for a randomized controlled trial

Helle Nystrup Lund (✉ [hnl@m.dk](mailto:hnl@m.dk))

Aalborg Universitetshospital <https://orcid.org/0000-0001-7358-3030>

Inge Nygaard Pedersen

Aalborg University Hospital, Psychiatry

Søren Paaske Johnsen

Aalborg University Hospital, Psychiatry

Agnieszka Maria Heymann-Szlachcinska

Aalborg University Hospital, Psychiatry

Maryla Tuszewska

Aalborg University Hospital, Psychiatry

Gustav Bizik

Aalborg University Hospital, Psychiatry

Jens Ivar Larsen

Aalborg University Hospital, Psychiatry

Eszter Kulhay

Aalborg University Hospital, Psychiatry

Anelia Larsen

Aalborg University Hospital, Psychiatry

Bettina Ellen Grønbech

Aalborg University Hospital, Psychiatry

Helle Østermark

Aalborg University Hospital, Psychiatry

Heidi Borup

Aalborg University Hospital, Psychiatry

Jan Brink Valentin

Aalborg University Hospital, Psychiatry

Jan Mainz

Aalborg University Hospital, Psychiatry

---

Study protocol

**Keywords:** Music, insomnia, depression, sleep

**Posted Date:** June 11th, 2019

**DOI:** <https://doi.org/10.21203/rs.2.10219/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

**Version of Record:** A version of this preprint was published at Trials on April 3rd, 2020. See the published version at <https://doi.org/10.1186/s13063-020-04247-9>.

# Abstract

Background Insomnia is a common sleep disorder for adults with depression with major impact on the quality of life. Previous trials suggest that music listening may be helpful in the treatment of sleep disturbances in healthy populations including students and elderly. In addition, small studies with clinical populations of traumatized refugees, adults with chronic insomnia and adults with depression insomnia add to the evidence base. However, the impact of music listening in the treatment of depression related insomnia is not well documented. Objective To examine the efficacy of music listening on sleep quality, symptoms of depression and quality of life in adults with depression related insomnia. Method A single center randomized controlled trial (RCT) in a two arm parallel group design is conducted and reported according to the Consort guidelines. The trial consists of an experimental group and a standard care control group. Both groups receive standard treatment for depression following Danish guidelines in an outpatient unit in psychiatry. The experimental group listen to music minimum 30 minutes at bedtime in four weeks. Discussion This study will provide information on the efficacy of music intervention as a non-pharmacological intervention in the treatment of depression related insomnia. This study will provide novel knowledge concerning music medicine as an evidence based treatment of depression in psychiatry. Trial Registration: Clinicaltrials.gov. ID NCT03676491, registered on 19th of September 2018.

## Background

Depression is a common health problem and an increasing global burden. WHO reports unipolar depression to rate third highest burden of disease with a prognosis to rank first place in 2030 [1]. A result of depression is the loss of social and cognitive functions and quality of life. One of the symptoms in depression is reduction in sleep quality (insomnia). Sleep disturbances associated with depression include difficulties in falling asleep and maintaining sleep. Cognitive behavioral therapy (CBT) is recommended in clinical guidelines as first line treatment [2] [3]. Other treatment modalities for sleep promotion include sleep hygiene, physical activity, light therapy, relaxation techniques, music/nature sounds and acupuncture [4]. Resolving sleep disturbances in patients with active or previous depression is important as it may prevent worsening of symptoms and relapse of depression [1].

Music listening is widely used as a sleep aid [4][5]. This practice is supported by a recent Cochrane review concluding that music may be helpful in improving sleep quality in insomnia [6][5]. The review underlines that the small sample sizes of the studies performed so far is a major limitation and concludes that there is a need for additional intervention studies concerning the effect of music listening on insomnia on specific populations including patients with depression.

Moreover, a systematic review shows that music listening may reduce symptoms of depression in adults when the music listening is conducted regularly for more than 3 weeks [7]. It was described that patients responded more when given a choice of music [5].

Giving a choice of music and offering a selection of music with a variety to meet individual preferences are both important factors highlighted in research [8][9]. New research should offer a broad selection of calm music to meet these criteria [6].

Patient selected music has a risk of being too stimulating (affect evoking or too dynamic i.e. increasing pulse and respiratory rate)[10]. Therefore, playlists designed purposefully by music therapists are more likely to have a sleep inducing effect [8].

Music preference and culture have an influence on the music listening experience. The perceived quality of the music depends on age, gender, preference, musical training and cultural belonging [11]. Music listening is a complex experience that influences the individual in many ways, not strictly in relation to sleep and relaxation, but also in relation to wellbeing and sense of self [11]. An improved sense of wellbeing may positively affect the subjective feeling of restedness. The association between wellbeing and quality of sleep is known and reported in literature [12].

This study aims to add knowledge into these domains investigating wellbeing by quality of life questionnaires as well as subjective and objective measures of sleep quality.

### Feasibility study

We have carried out an observational feasibility study introducing music listening as a non-pharmacological intervention to improve sleep quality for patients with depression [13]. Outpatients diagnosed with unipolar depression and sleeping problems (n=11) were asked to listen to music for at least 30 minutes before going to sleep every night for a period of 4 weeks. Music listening was provided by a sound pillow equipped with an mp3 player containing 10 playlists of 30-60 minutes relaxing music with different music styles (classical, easy listening, pop, rock) based on the literature of receptive Music Therapy [14]. The study indicated signs of improved sleep quality [13]. However, the study lacked of control group.

### Rationale for a randomized trial

Effective treatment modalities are in demand to supplement existing treatment of insomnia in depression. The positive effect of music on sleep quality has been reported in a number of study settings with clinical and nonclinical populations [6]. This study contributes to the investigation of the efficacy of music listening in the treatment of depression related insomnia by combining subjective measures (self-reported data) and objective measures (accelerometer). In addition, a new app with special designed playlists makes a large selection of music available to meet individual preference.

## Method

### Aim & hypothesis

The aim is to examine whether music listening is effective in improving sleep quality, reducing symptoms of depression and improving quality of life in patients with depression related insomnia.

The following hypothesis is tested:

The controlled use of a sound pillow (figure 1) in combination with the Music Star app (figure 2) can serve as a sleep aid in reducing depression related sleep disturbances, reducing symptoms of depression and improving quality of life.

Figure 1 and 2 near here

Definitions:

Music listening, music intervention and music medicine refer to the use of music as an intervention without an active music therapist. In this protocol, music listening implies listening to pre-recorded music.

Insomnia, sleep disturbances and sleeping problems refer to a broad understanding of the disorder. Symptoms include difficulties initiating and maintaining sleep.

The study is named MUsic STAr For Insomnia (MUSTAFI).

Trial design

A single center randomized controlled trial in a two arm parallel group design is conducted from May 2018 to December 2019 following the revised Consolidated Standards of Reporting Trials (CONSORT) guidelines [15]. The RCT includes two groups of participants, an experimental group and a waitlist control group. Both groups receive standard treatment for depression following national guidelines.

Figure 3 near here

The duration of the intervention is 4 weeks. The participants are followed for 8 weeks. Participation takes place in the home of the patient. In addition, three scheduled visits to the hospital in relation to the research project are required. Baseline assessment is performed on the starting day. Follow up measurements are performed after 4 and 8 weeks (figure 3).

The black element in the left bottom of figure 3 illustrates the intervention given as an option to the waitlist control group. The participants may take home the sound equipment for four weeks. There is no data collection involved. This has been added to the study for ethical reasons and to limit drop out from the control group [16]. The schedule for the trial is described in the SPIRIT flow chart (figure 4) and the dimensions of the study protocol has been described adhering to the SPIRIT Checklist (Additional File 1).

Figure 4 near here

Sample size

Based on a previous study, we assume that the mean decrease in Pittsburgh Sleep Quality Index (PSQI) scale is 3.04 (SD 2) points for the music intervention group and 2.04 (SD 1.67) points for the waitlist control group [17]. When estimating the sample size, we assume that 25% of the eligible patients will be willing to participate in the project. Based on the patient flow in the outpatient clinic and the available resources from the staff recruiting the patients, we assume that a total of 120 participants can be recruited over a period of 18 months. A dropout rate of 20% is expected. Hence, a total of 100 randomized patients are expected to complete the study. With 100 patients (n=50 per group) the power of our study is 76% (at a confidence level of 5%).

## Setting and Participants

The study will be conducted at a single study site: the Unit for Depression in Psychiatry at Aalborg University Hospital, Denmark. The participants are adult outpatients aged 18-65 years in treatment for unipolar depression in the Northern part of Denmark.

Patients are referred to the unit for depression with different backgrounds. Some patients have not previously been associated with psychiatry and are referred directly from private practice with moderate or severe symptoms of depression. Another group of patients are referred from an inpatient unit. These patients are in recovery and have a stabilized condition in need of follow up treatment after discharge. A third group of patients has been diagnosed in previous contact or hospitalization and in need for treatment after a recurrent depression.

## Inclusion criteria

All patients are required to have a diagnosis of unipolar depression (ICD-10 Depressive singular episode F32 or Periodic depression F33) and sleeping problems identified by the Hamilton Depression Rating Scale (HAM-D) by a score of at least 2 of a single item or at least 3 in total for the three items (sleep items 4-6). In addition, the patients should receive treatment according to national guidelines for depression. This may include pharmacological treatment, psychotherapy, psycho education and electro convulsive therapy. Participants are eligible if within age 18-65, in stabilized pharmacological treatment and having at least four weeks of treatment.

## Exclusion criteria

Exclusion criteria are unipolar depression with psychotic episodes, substance or alcohol abuse or sentence to treatment by law. Patients will be excluded if they have restless legs syndrome, obstructive sleep apnea or other organic sleep disorders as well as hearing loss. In addition, patients with a dislike of music will be excluded.

## Recruitment

Patients are recruited in the Unit for Depression. Nurses, psychiatrists and psychologists use the screening tool 4 weeks after beginning of treatment or after medical treatment is stabilized. Participants

are recruited through posters, information by doctors and word of mouth in the unit. After an initial assessment for eligibility, the patient is informed of the option to participate. The recruitment takes place during group meetings or during individual consultation in the unit. When the patient has declared an interest to participate, the psychiatrist of the patient fill out an inclusion document based on information from the patient journal and his/her knowledge of the patient. The document is forwarded to the research leader. If the patient is eligible, the music therapist makes an appointment to give detailed information on participation in the research project.

Patients are included according to the inclusion and exclusion criteria. The patient may be discharged during participation in the research project and finalize as a private person. If the increase in depression symptoms result in hospitalization, the patient may continue participation in agreement with caretakers in the unit. If the patient is changing medication but is interested in participation, the patient will be registered on a waitlist for inclusion.

### Informed consent

The patient may sign the informed consent after receiving oral and written information about the research project. The information explains the aim and the procedures of the research project, the use of sound equipment and accelerometer and the rights as a participant in a scientific health study. The patient has the option to ask questions and if the patient need time to consider the participation, the music therapist offer to call the patient after one week and a new meeting is set up for the signing of the informed consent. When the informed consent is obtained and the inclusion criteria are confirmed in the inclusion document, the music therapist proceeds with the randomization. An additional consent for collection and use of log file data from accelerometer and the Music Star app is signed after randomization. Documents of informed consent are kept in a securely locked place.

### Randomization

Randomization takes place when the inclusion document has confirmed eligibility and the informed consent has been signed following the regulations of the The North Denmark Region Committee on Health Research Ethics. Randomization is carried out by the use of REDCap (Research Electronic Data Capture) hosted at Aalborg University Hospital. REDCap is a secure web-based application designed to support data capture for research studies. The randomization will be stratified according to age, i.e., under 30 years vs. 30 years and above. Randomization is performed using computer-generated block randomization (random block sizes 2-8) with 1:1 allocation between the intervention group and the waitlist control group.

### Procedure

The principal investigator is assigned to give information on the research project to groups and individuals by team members and coming to the unit by appointment. When offering a thorough

information to obtain informed consent, the music therapist takes the participant to the music therapy clinic situated in a hospital building close by.

### Experimental Intervention

The music intervention consists of listening to music with the use of a sound pillow applying the music from The Music Star app with special designed playlists. The duration of music listening for 30 minutes minimum at bedtime is guided by previous studies [6]. The principal investigator HNL gives an oral guideline to music listening and use of sound equipment at the baseline appointment. Adherence to the intervention (30 min of bedtime music) is monitored through log file data from the Music Star.

Instructions concerning the experimental intervention:

- It is required that you listen to music of your choice from the Music Star at least 30 min. at bedtime every night in four weeks. You may use The Music Star during the night or in the early morning hours if you wake up and have difficulties falling asleep again.
- You may turn off the Music Star if you wake up when the music plays and it is disturbing.
- The music will automatically stop when the playlist ends after 30 or 60 minutes
- You may use The Music Star in the daytime to assist a rest. It is important only to use The Music Star for relaxation and sleep.
- You are advised to listen to the different available music to select your preferred playlists. You may select a particular playlist to play every night. Some people find that it is helpful to let a specific piece of music be a signal for sleep initiation.
- Consider choosing music that you like and that may help you fall asleep.
- You have to listen to music at night in the way it is described for the research purpose, i.e. the sound pillow in combination with The Music Star app.
- You may listen to your own music during the daytime.

Instructions on the use of the sound equipment:

- Place the sound pillow in your bed (remove your own pillow) and place The Music Star close to the bed on a small table or chair for easy access during the night.
- Make sure that you have recharged The Music Star during the day.
- If you have technical problems with the sound equipment, you may contact the research leader by phone from 9-12 on weekdays.

## Instruments

The data are derived from four questionnaires (three are self-reported and one is scored by the psychiatrist, researcher or project nurse) and log file data from the accelerometer and from The Music Star app. The references concerning validation of each instrument below are selected according to their relevance to this study.

The Pittsburgh Sleep Quality Index (PSQI) is a commonly used questionnaire measuring self-reported sleep habits in clinical populations in research and clinical practice [18]. A Danish version of the questionnaire will be used [19]. The items refer to sleep habits and disturbances within the last month. The 19 items are divided in 7 domains: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, daytime dysfunctions and use of antidepressant agents. The seven components form a global score ranging from 0 to 21, each component with a range from 0 to 3. Buysse reported a score of >5 (indicating poor sleep) yielded a diagnostic sensitivity of 89.6 % and a specificity of 86.5% [18]. The scale shows good homogeneity with an internal consistency, with  $\alpha = 0.83$ . Acceptable measures of validity were obtained through the ability to distinguish between clinically distinct groups and comparing these with polysomnographic results [19]. A score of > 5 is indicative of severe sleep difficulties in at least two areas, and separating participants in two categories "good" and "poor". PSQI is validated in psychiatric populations [20].

The Hamilton Depression Scale (HAM-D17). The HAM-D17 consists of 17 items [21]. The items cover the depressive state, the unspecific stress and arousal symptoms, the suicidal thoughts and lack of insight. The respondent is asked to consider the last three days when responding.

Each item in the score is rated from 0-4 or 0-2, the higher number indicating an increase in the symptoms of depression. A guide to the Hamilton rating questioning is used in combination with a rating sheet. The total score indicates the severity of depression symptoms graduating in four categories from unlikely depression to severe depression, with 8-12 indicating minimal depression, 13-17 indicating light depression, 18-24 indicating moderate depression and 25-52 indicating severe depression.

The Hamilton Depression Rating Scale in the 17-item version is validated [22].

The World Health Organization Well-Being Index. (WHO-5). The 5-item World Health Organization Well-Being Index (WHO-5) is among the most widely used questionnaires assessing subjective psychological well-being [23]. It measures subjective quality of life based on positive mood (good spirits, relaxation), vitality (being active and waking up fresh and rested), and general interest (being interested in things). WHO-5 only contains positively phrased items. The WHO-5 items are: (1) 'I have felt cheerful and in good spirits', (2) 'I have felt calm and relaxed', (3) 'I have felt active and vigorous', (4) 'I woke up feeling fresh and rested' and (5) 'My daily life has been filled with things that interest me'. The respondent is asked to rate how well each of the five statements applies to him or her when considering the last 14 days. Each of the five items is scored from five (all of the time) to zero (none of the time). The score therefore

theoretically ranges from zero (absence of well-being) to 25 (maximal well-being). The use of WHO-5 as a measure of severity of depression is validated [24].

The World Health Organization Quality of Life (WHOQOL-Bref). In 1991, the World Health Organization initiated a project with the aim of developing an international, cross-culturally comparable QOL assessment instrument. "It assesses the individual's perceptions in the context of their culture and value systems, and their personal goals, standards and concerns. The WHOQOL instruments were developed collaboratively in a number of centres worldwide, and have been widely field-tested." [25]. The WHOQOL-BREF instrument is a shorter version of the original 100 item self-report questionnaire, comprising 26 items measuring four domains: physical health, psychological health, social relationships and environment. In each question, the respondent reports his/her QOL in the four domains on a five point Likert scale. A high score reflects the subjective experience of high QOL. The use of WHO-QOL Bref is validated [26].

The Music Star app. An app designed for iPad in 2014. The Music Star is a self-explanatory user interface to select music from specifically designed playlists. Music therapists have selected the music for the playlists. The app has a built-in log function that registers each event when using the app. The Music Star gives information from log files of music played, time and duration [24].

The 16 playlists of 30-60 min duration are represented by colored triangles forming a star. The four playlists in shades of blue are the most quiet and simple (lowest stimuli), the four playlists in shades of green include some variation and dynamics (moderate stimuli), the four playlists in shades of red have more intensity (highest stimuli). The grey triangles are intended to contain playlists for specific purposes. A grey triangle contains the only non-music playlist of 'Summer Rain' consisting of sounds of rain and bird sounds. The rain sound adds a non-music track for the purpose of variety in sound stimuli to meet individual preferences. Two other grey triangles contain special designed playlists for sleep. The classification of music is correlated to the degree of complexity and tension of the musical stimulus based on the taxonomy of music by Wärje & Bonde [25]. The playlists in The Music Star are all categorized in subdivisions of supportive music according to the taxonomy of music. The two sleep playlists have a 30 minutes duration. Sleep 1 is a short version of a playlist with music specially composed for relaxation and sleep including a male voice humming. Sleep 2 is a playlist with a guitar-bass jazz duo playing slow ballads. Sleep 1 and 2 are included for meeting criteria of minimum duration and variety in the music selection. More than 100 music pieces in different genres are available in the playlists.

Accelerometer. One tri-axial accelerometer with on board memory (Axivity Ax3, United Kingdom) placed in a wrist bracelet will be used to measure arm movement during the night. The measurement range was set to  $\pm 8G$  with a sampling frequency of 25 Hz. A sleep analysis function using a generic algorithm will provide data on sleep duration. Assessing sleep duration with accelerometer is validated [26].

Outcome measures

## Primary outcome measure

The primary outcome measure will be changes in sleep comparing the total score of the PSQI-DK assessed at baseline, after four and eight weeks. The sleep quality assessed with PSQI-DK is compared with sleep estimates from accelerometer data considering total hours of sleep per night.

## Secondary outcome measures

The secondary outcomes will be 1) log file data from the accelerometer. This provides additional data on total hours of sleep per night. The total hours of sleep per night in the experimental group is compared with waitlist control group after 4 weeks 2) HAM-D provides data on the total depression score 3) the WHO-5 and WHO-QOL provide data on the self-reported quality of life. Additional log file data is collected from the Music Star app. All outcome measures are collected at baseline, after four weeks experimental/wait-list control and again after four weeks follow up. In addition, registration of pharmacological treatment during the period of participation is included in the data collection.

## Demographics

At baseline, demographic information including age, sex, ethnicity, and partnership, children living at home, handedness, diagnosis code for present depression, first diagnosis of depression and first psychiatric diagnosis will be gathered. In addition, the participant may add self-reported other disease and/or diagnosis. Work status and education, alcohol use and present use of music for sleep will be registered.

## Statistical methods

We initially perform a descriptive analysis on age, gender, medication, illness duration etc. The two groups are compared within groups and between groups using F-tests and chi-squared tests. Additionally we compare the groups on outcome measures at baseline.

Data analysis for the RCT will be performed using mixed effects linear regression with subject specific random effects. The intervention group will be initially compared with the control group on change of all outcome measures after four and eight weeks. Age and gender will be added as covariates in all regression analyses. Repeated-measures analysis of variance (RM-ANOVA) will be used to compare results from baseline follow up one and follow up two.

Finally, a descriptive analysis of the playlists is included in the study, i.e. analysis of playlist preferences (style, duration, time of day) in the group of patients benefitting most from treatment compared to the group of patients benefitting the least.

Blinding of the researchers performing the scorings before and after the treatment as well as the subjects of the study will not be possible. Patients will be anonymized when analyzing data. All main analyses will be carried out based on the intention-to-treat principle.

## Data management

Data management is carried out by the use of REDCap. Double data entry is performed by research assistants.

## Ethics

The study is approved by the local ethics committee (N-20170055) and registered by the Danish Data Protection Agency (ID 2017-236). A yearly report of adverse events and other unintended effects of the trial is obtained by the local ethics committee.

## Dissemination

Results of the study are published in open-access peer reviewed scientific journals and presented at international scientific conferences. Broadcast of findings in Danish radio and TV media will be planned through the study.

# Discussion

The aim of this RCT is to investigate the efficacy of music medicine compared with standard care. In order to increase the clinical value of the research, the inclusion and exclusion criteria have been selected to target a group of depressive patients who have serious sleep disturbances. This group of patients is less likely to respond to interventions such as cognitive behavioral therapy. Further, there is an augmented risk of relapse and suicide [27][28]. Sleep disturbances in depression result in a slowdown of the recovery process for the individual and this is costly for the individual and for the society [12].

If music medicine using the Music Star app combined with a sound pillow shows to be effective in improving sleep, it may not only have a positive effect on sleeplessness but also promote compliance with treatment and increase overall functioning [27].

## Limitations

The primary outcome measure is self-reported sleep. Negative thinking is a symptom in depression that may influence self-rating. The HAM-D17 rating is not performed by one consistent person in all cases. Inter-rater reliability has not been tested and may cause bias.

This study does not consider issues of comorbidity. For some patients sleep disturbances have been present long before the onset of depression. In this study, sleep disturbances are associated with depression although the comorbid presentation of depression and insomnia may be complex.

## Trial status

Recruitment take place from 23 May 2018 to end of February 2020. In May 2019 42 participants are included in the study. The current protocol version is number 3 dated 17 October 2018.

# Abbreviations

HAM-D: Hamilton Depression rating Scale, PSQI: Pittsburg Sleep Quality Index, WHO-5: The 5-item World Health Organization Well-Being Index, WHOQOL-Bref: World Health Organization Quality of life Questionnaire, RCT: Randomized Controlled Trial, REDCap: Research Electronic Data Capture

# Declarations

## Acknowledgements and Funding

We thank Lars Ole Bonde for assistance adjusting the study design and Lars Rye Bertelsen for setting up software and data collection for The Music Star. We thank Maria Rodrigo Domingo for statistical assistance, Simon Grøntved for setting up software (REDCAP) and Mette Munk for administrative assistance. We thank the patients who gave consent to participate.

The study is funded by Clinic South, Aalborg University Hospital - Psychiatry, The Obel Family Foundation, Aase and Ejnar Danielsens Foundation, The Danish North Region Health Research Foundation. We thank the funding bodies for vital financial support. The funding bodies have no role or authority over any part of the research or publication of the trial.

## Availability of data and material

The datasets used during the current study are available from the corresponding author on reasonable request.

## Author details

Affiliation: Clinic South, Aalborg University Hospital, Psychiatry, Mølleparkvej 10, 9000 Aalborg, Denmark

Corresponding Author Helle Nystrup Lund, Music Therapist, PhD Student, Psychiatric Research Unit, Mølleparkvej 10, 9000 Aalborg, Denmark. Phone: +4597644830 E-mail: [hnl@rn.dk](mailto:hnl@rn.dk)

## Authors contributions

HNL, INP, SPJ, AMH-S, MT and JM made contributions to the study protocol. GB, JIL, EK, AL, BG, HB and HØ helped drafting recruiting procedures and carries out recruitment. JBV contributed to the statistical part of the protocol. All authors have read and approved of the final manuscript.

## Ethics Approval and consent to participate

The study was approved by the North Denmark Region Committee on Health Research Ethics on 5 September 2017; N-20170055 case number 58691. Additional applications have been approved 15 March 2018 and 17 October 2018 case number 62478. Protocol version number 3. Participants sign an informed

consent to participate. Additional consent for collection and use of log data from the accelerometer and The Music Star app is signed by all participants.

Consent for publication

Not applicable.

Competing interests

HNL is co-inventor of the Music Star App and has economic interest in the research due to ownership and sales of the Music Star app. The Music Star app is commercialized in collaboration with the company AudioCura which delivers sound equipment to Aalborg University Hospital. The company has no influence on the research. The inventors follow the Ethical Principles by the Danish Union of Music Therapists (Dansk Musikterapeutforening). HNL is responsible for data collection. A statistician is responsible for data analysis. The authors INP, SPJ, AMH-S, MT, GB, JIL, EK, AL, HØ, BG, HB, JBV and JM declare that they have no competing interests.

## References

1. The World Health Organization. The Global burden of disease: 2004 update Part 4. *Glob Burd Dis* 2004 Updat. 2008;40–51.
2. Sundhedsstyrelsen. National Klinisk Retningslinje for Unipolar depression. 2016.
3. Riemann D, Baglioni C, Bassetti C, Bjoervatn B, Dolenc Groseelj L, Ellis JG, et al. European guideline for the diagnosis and treatment of insomnia. *J Sleep Res*. 2017;26:675–700.
4. Chen, J, Liu J H, Xu, N, Liang, Z H XS-JXW-BF. Journal Article Effects of acupuncture treatment on depression insomnia: a study protocol of a multicenter randomized controlled trial. *Trials*. 2013;14:2.
5. Trahan T, Durrant SJ, Müllensiefen D, Williamson VJ. The music that helps people sleep and the reasons they believe it works: A mixed methods analysis of online survey reports. *PLoS One*. 2018;13:1–19.
6. Jespersen K, Koenig J, Jennum P, Vuust P. Music for insomnia in adults. *Cochrane Database Syst Rev*. 2015;
7. Chan MF, Wong ZY, Thayala N V. A systematic review on the effectiveness of music listening in reducing depressive symptoms in adults. *JB I Libr Syst Rev*. 2010;8:1242–87.
8. Short A, Ahern N. Evaluation of a systematic development process: relaxing music for the emergency department. *Aust J Music Ther*. 2009;20:3–26.

9. Bonde LO. Playlists and patients' preferences: Comments on Short & Aherns article 'Evaluation of a systematic development process: Relaxing music for the emergency department'. *Aust J Music Ther.* 2008;20:27–9.
10. Bradt J, Dileo C, Grocke D. Music interventions for mechanically ventilated patients. *Cochrane Database Syst Rev.* 2010;12:CD006902-CD006902.
11. MacDonald, R, Kreutz, G, Mitchell L. Ch 1- Introduction: What is music, health and wellbeing and why is it important. *Music Heal Wellbeing.* 2012;2–12.
12. Garbarino S, Lanteri P, Durando P, Magnavita N, Sannita WG. Co-morbidity, mortality, quality of life and the healthcare/welfare/social costs of disordered sleep: A rapid review. *Int J Environ Res Public Health.* 2016;13.
13. Lund HN, Pedersen IN. Pilot project: Sound pillow treatment to improve sleep quality for patients with depression or bipolar diagnosis with sleeping problems. 24th Eur Congr Psychiatry, EPA 2016 Madrid Spain. Elsevier Masson SAS; 2016;33:S80.
14. Grocke DE, Wigram T. Receptive methods in music therapy : techniques and clinical applications for music therapy clinicians, educators, and students. England: Jessica Kingsley Publishers; 2007.
15. Altmann, D G., Schulz, K F., Moher, D., Egger, M., Davidoff, F., Elbourne, D. et al. The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *CONSORT 2010 checklist of information to include when reporting a randomized trial.* 2010;11–2.
16. Bradt J. Randomized controlled trials in music therapy: Guidelines for design and implementation. *J Music Ther.* 2012;49:120–49.
17. Deshmukh AD, Sarvaiya AA, Nayak AS. Effect of Indian classical music on quality of sleep in depressed patients: a randomized controlled trial. *Nord J Music Ther. Department of Psychiatry, BYL Nair Charitable Hospital, Mumbai, India: Routledge;* 2009;18:70–8.
18. J Buysse D, F Reynolds C, H Monk T, R Berman S, J Kupfer D. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28:193–213.
19. PSQI – Denmark/Danish – Version of 24 Feb 06 - Mapi. :4–7.
20. Liu XC, Tang, MQ HL et al. Reliability and validity of the Pittsburgh sleep quality index. *Chinese J Psychiatry.* 1996;29:103–7.
21. Hamilton M. A rating scale for depression. *J neurol Neurosurg Psychiatr.* 1960;23:56–62.
22. Bobo, William W. Angelero, Gabriela C. Jenkins, grogory, Hall-Flavin, Daniel K., Weinshilboum, Richard, Biernacke JM. Validation of the 17-item Hamilton Depression Rating Scale definition of response for

adults with major depressive disorder using equipercntile linking to Clinical Global Impression scale ratings: analysis of Pharmacogenomic Research Network Antidepress. *Hum Psychopharmacol*. 2016;40:3070–7.

23. Topp, CW, Østergaard, S D, Søndergaard, S BP. The WHO-5 Wellbeing Index: A systematic review of the literature. *Psychotehrapy and Psychosomatics*, 84. 2015. p. 167–76.

24. Lund HN, Bertelsen LR, Bonde LO. Sound and music interventions in psychiatry at Aalborg University. *Sound Eff - An Interdiscip J Sound Sound Exp*. 2016;6:48–68.

25. Warja M, Bonde LO. Music as co-therapist: Towards a taxonomy of music in therapeutic music and imagery work. *Music Med*. 2014;6:16–27.

26. Van Hees VT, Sabia S, Anderson KN, Denton SJ, Oliver J, Catt M, et al. A novel, open access method to assess sleep duration using a wrist-worn accelerometer. *PLoS One*. 2015;10:1–13.

27. Fava M. Daytime sleepiness and insomnia as correlates of depression. *J Clin Psychiatry*. 2004;65:27–32.

28. Jindal RD, Thase ME. Treatment of insomnia associated with clinical depression. *Sleep Med Rev*. 2004;8:19–30.

## Figures



**Figure 1**

Selected solution-enabling music listening. A sound pillow is a pillow with small internal speakers. The sound pillow features a port through which to connect a player (Mp3/iPad/mobile phone). The user selects the music on the player. (Photo courtesy Sound Oasis).



**Figure 2**

The Music Star is an app developed for iPad to select music from a number of special designed playlists. Each playlist is represented by a colored triangle forming a star. (Photo courtesy Musikstjernen IVS)

Figure 1

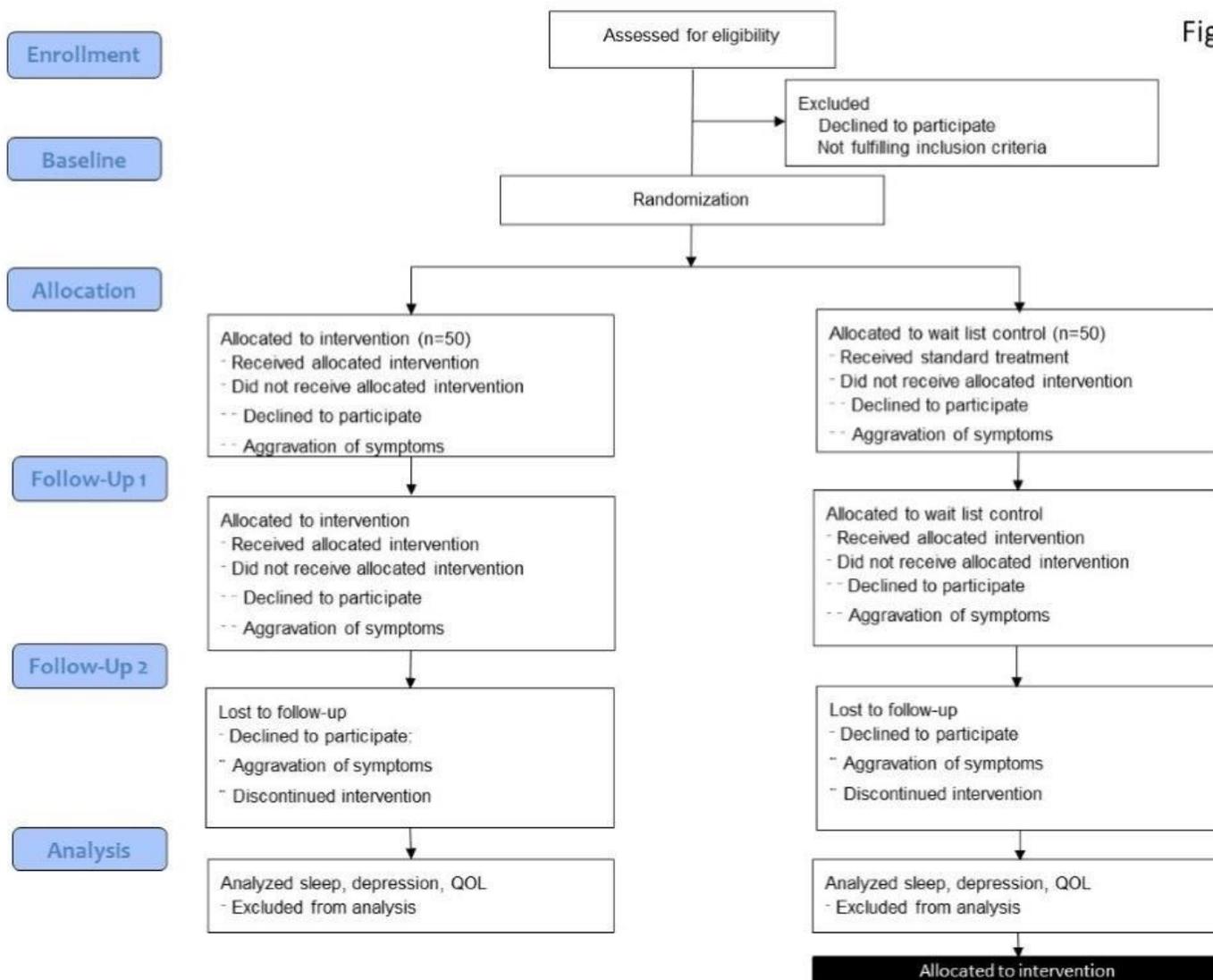


Figure 3

Flow Diagram of MUSTAFI phases including enrolment, allocation, follow up and data analysis.

STUDY PERIOD							
	Enrolment	Allocation	Post-allocation				Follow Up
TIMEPOINT	$-t_1$	0	Week 1-2	Week 3-4	Week 5-6	Week 7-8	Week 9
<b>ENROLMENT:</b>							
Eligibility screen	X						
Informed consent	X						
Allocation		X					
<b>INTERVENTIONS:</b>							
<i>Music</i>			X	X			
<i>Control</i>			X	X	X	X	
<b>ASSESSMENTS:</b>							
<i>PSQI, WHO-5, WHOQOL-bref, HAM-D</i>			X		X		X
<i>Accelerometer</i>					X		X
<i>Log file data Music Star</i>					X		

Figure 4

Schedule of enrolment, interventions and assessments (Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) flow chart).

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplement1.pdf](#)