Project Description

Enhancement of presence, compassion and resilience – bringing the practice of mindfulness into nature

(Preventing mental fatigue in healthcare providers).
A pilot study

Resume

Stress, mental fatigue and associated illnesses such as depression and anxiety are growing global problems. Huge effort is being made in finding ways to prevent and treat these illnesses in medical- and psychological research, as well as in alternative fields such as mindfulness meditation and exposure to the natural environment. It seems to be promising paths to follow. A combination of the two fields may even have a synergistic effect, but that has only been the object of attention in a few small studies. Thorough investigation could possibly create a more solid basis for useful future applications.

In this randomized controlled trial, 66 Danish bachelor and master students are randomly distributed in three groups receiving five days residential mindfulness training indoor, five days residential mindfulness training in natural environment or no treatment (controls). To investigate the hypothesis that mindfulness training in nature is more stress reducing and attention restoring than training mindfulness indoor, data were collected before and after the five days training and at 3-months follow up. Data included biological measures on gene expression, protein markers and heart rate variability; psychological measures from questionnaires on stress, mindfulness, self-compassion and connectedness to nature; and behavioral measures on concentration from a computer program, as well as qualitative data from interviews. Data are now being analysed and results will be communicated during the coming year.

Background

A growing number of studies indicate the positive outcome of interacting with natural environments in relation to mental and physical health (e.g. Maller et al., 2008; Nilsson et al., 2011, Kuo, 2015, Hansen et al., 2017). This has given rise to an integration of natural environments in health promotion and treatment for different target groups based on the hypothesis that natural environments can support and add new dimensions to the healing process compared to treatment indoors.

But still there is limited knowledge on the effect of nature-based interventions. Therefore, the University of Copenhagen has initiated two research projects during the last five years on nature-based treatment (NBT). The projects were based on integrated knowledge from the field of landscape architecture, clinical knowledge and case specific knowledge on the target group (Stigsdotter, 2014). They were conducted in the Therapy Forest Garden Nacadia®, designed by Ulrika Stigsdotter to ensure optimal conditions for stress reduction. The first project had soldiers with PTSD as a target group. The latter was a combined RCT and qualitative research project for people on sick-leave due to stress. Here NBT, including mindfulness training, was compared to indoor cognitive behavioral therapy. The findings in the two projects show promising potential in using nature-based interventions, including mindfulness, for treatment on stress related illness and promoting good mental health (Poulsen, Stigsdotter & Djernis, 2016; Sidenius, Refshauge & Stigsdotter, 2015).

Working as a managing horticultural therapist in the projects mentioned above, questions and insights arose through my practice, observations and evaluations of the nature-based

interventions. In the present study my aim is to lift up this experience-based knowledge to a scientific level, and enable investigation into the psychological and physiological impact of bringing mindfulness training into nature.

Existing Theory and research – the combination of mindfulness and exposure to nature

Most research on nature's impact on human health refers to three theories; Roger Urich's Aesthetic Affective Theory (AAT), Edward O. Wilsons's Biophilia Hypothesis, and the Attention Restoration Theory (ART) developed by Kaplan & Kaplan (1995). ART, which is often considered to be the most central (e.g. Hansen, 2017), indicates that directed attention is a limited resource, and will cause mental fatigue if not restored. Exposure to the natural environment is, according to the Kaplans, one way to restore directed attention when it offers fascinating but still relaxing sensory stimulation. This automatically captures the spontaneous attention (Kaplan, 1995). Kaplan has compared the state of absorbed attention to states obtained by traditional meditative practices (2001). Stress and fatigue of attention often co-occur in research, but may not always have a causal relation (Kaplan, 1995). Both will be objects of investigation in this project.

Qualities of environment potentially restorative for directed attention, according to the ART
"Being away: being distinct, either physically or conceptually, from the everyday environment
Fascination: containing patterns that hold one's attention effortlessly
Extent: having scope and coherence that allow one to remain engaged; and
Compatibility: fitting with and supporting what one wants or is inclined to do"
(Kaplan, 2001)

Figure 1, Definition of restorative environment.

Mindfulness meditation has been practiced for thousands of years, mainly in Asia. In the 1970s Jon Kabat-Zinn, PhD, created a program called Mindfulness Based Stress Reduction (MBSR) on the basis of the old meditation traditions, and brought it into mainstream western medicine. In his book "Full Catastrophe of Living" (Kabat-Zinn, 1990) he explains the basis and applications of mindfulness. Research in mindfulness is more clinically and less theory based. It is by now well established that participation in 8-week MBSR programs correlates with lower stress levels. Attention training is a central part of mindfulness meditation, but other components such as positive reappraisal (Garland, 2011) and self-compassion (Allen, 2010) are pivotal for stress reduction

" **Mindfulness** has to do with particular qualities of attention and awareness that can be cultivated and developed through meditation. An operational working definition of mindfulness is: the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment." (Kabat-Zinn, 2003)

Figure 2: Definition of mindfulness

An expanding body of research documents nature's stress reliving potential (e.g. Nilsson et. al., 2011, Hansen et al., 2017) and the nature's potential for attention restoration (Schuttle et al. 2015). Also an exponential growing number of studies show that meditation improves the ability to pay focused attention (Jensen et al., 2012) and to reduce stress and related illnesses (e.g. Bratman et al., 2015, Sedlmeijer, 2012, Gu et al., 2014). Whereas research within the two fields thus covers stress reduction and attention restoration, little research has been conducted looking for the effect of combining meditation and nature exposure (Lumeus et al., 2016).

In one small trial fifty self-selected adults were included. Their mood, sense of connectedness to nature and willingness to engage in pro-environmental actions were assessed after two hours of meditating indoor, and then after two hours of meditation in natural settings. The findings were an elevation in mood meditating in nature (Rader, 2010). Other studies show a correlation between mindfulness level and the feeling of being connected to nature. An example is a study by Unsworth, Palicki, and Lustig (2016) where some of the students on a 3-day nature camp meditated 15 minutes a day in nature. Just after the camp they reported greater increase in connectedness with nature than those not meditating. All of the students reported increase in mindfulness ratings regardless of the meditation sessions.

Some research points to a connection between the effects of being in nature, the level of mindfulness and wellbeing (e.g. Wolsko, 2011, Steinberg, 2012, Rader, 2010).

Lumeus and colleagues (2016) investigated the attention level in twentyseven participants in an 8-week mindfulness program. A weekly 15 minutes intervention was conducted with some viewing nature images while meditating, some practicing traditional meditation and some resting (controls). Measurements of attention before and after intervention indicated that nature images enhanced the outcome of the mindfulness practice.

Hypotheses and aims

Research shows that both mindfulness training and exposure to supportive natural environment have the potential for reducing stress and restoring attention. The aim of this study is to gain knowledge on whether there is a synergistic effect combining mindfulness and exposure to a supportive natural environment. The hypothesis is, that mindfulness training in a supportive natural environment reduces stress and restores attention more than mindfulness training indoors.

Study design

Intervention

The study is a randomized controlled trial for three groups of moderately stressed students. Two groups received 5 days residential intervention including mindfulness. The third group is a control group (see figure 4, below). The only difference in conditions for the two mindfulness groups is the environment.

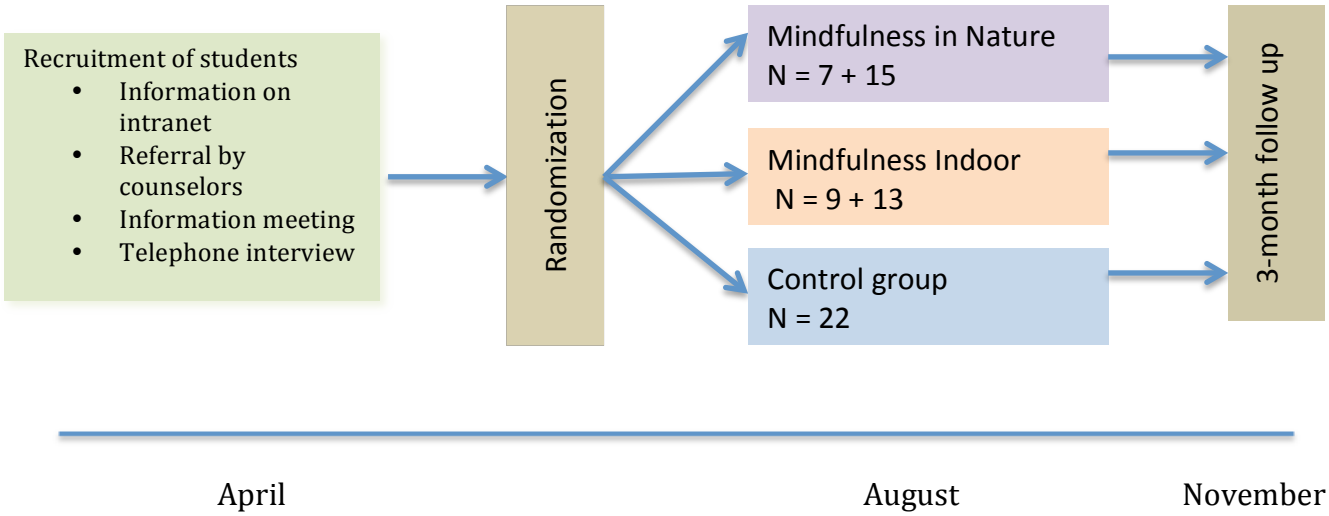

Figure 4. Overview of trial setup for interventions April-November in both 2016 and 2017

Methods and Measurements

A mixed method is employed to study the effect from both a psychological and a physiological perspective, and thus to gain a more holistic understanding of the impact of nature exposure and mindfulness practice.

Psychological measurements

To compare the impact of meditating indoors vs. in nature questionnaires are used to assess the perceived level of stress (Perceived Stress Scale – PSS, Eskildsen, 2009), of mindfulness (Five facet mindfulness questionnaire – Ffmq, Baer, 2008), self-compassion (Self Compassion Scale – SCS, Neff, 2003), and connection to nature (Connectedness to Nature Scale – CNS, Mayer and Frantz, 2004)

A validated computer-based behavioral test will supplement the Ffmq and SCS questionnaires to measure mindfulness, (Breath Counting, Levinson, 2014).

On the basis of individual semi-structured explorative interviews conducted just after intervention and at a 3-month follow up, Interpretative Phenomenological Analysis (IPA) will be made (Finlay, 2011). The aim is to get a better understanding of the dynamics between mindfulness training and exposure to nature when it comes to stress relief and attention/mindfulness restoration.

Biological and physiological measurements

Another way to investigate the impact of meditating on stress level, indoors vs. in nature, is to measure biological markers. The focus will be on gene expression, protein markers and heart rate variability (HRV).

Research shows that stressful experiences affect the organism at the cellular level influencing how our genes are expressed (Pallesen, Dahlgaard and Fjorback, 2016), in ways that undermine health. Even more intriguingly, stress reduction through mindfulness meditation, may reverse those effects resulting in genetic anti-stress changes (Dahlgaard and Zachariae, 2014; Pallesen, Dahlgaard and Fjorback, 2016). Gene expression measures are therefore included in the research, as a new approach in the field of studying changes in stress level. Molecular biological data from blood samples before and after intervention will be obtained to measure changes in gene expression (Dahlgaard and Zachariae, 2014; Pallesen, Dahlgaard and Fjorbak, 2016).

The physiological marker HRV will also be measured before and after the intervention. HRV is dynamic and strongly influenced by stress. During stress and activation of the sympathetic nervous system, the heart rate increases while the HRV is reduced (Porges, 1995; Steptoe & Kivimaki, 2012). For example, in posttraumatic stress syndrome (PTSD), heart rate during rest is typically increased (Buckley & Kaloupek, 2001), while HRV is decreased (Hauschildt, Peters, Moritz, & Jelinek, 2011; Shaikh-al-arab et al., 2011). Over the longer term, reduced HRV leads to immune dysfunction and inflammation, cardiovascular disease and mortality (Kemp & Quintana, 2013). Meditation has a documented effect on HRV, (Cysarz & Büssing, 2005; Lehrer et al., 1999; Peng et al, 1999; Peng et al, 2004, Wu & Lo, 2008). One study showed positive effects of mindfulness and HRV in a group of students (Prazak et al., 2011). In addition, heart rate is expected to decrease following meditation.

Background data

Relevant demographic data, measures on health and wellbeing, and use of nature has been collected the day before intervention as background data (for overview see figure 5).

	Just before intervention	Just after intervention	3-months follow up
Background data, questionnaires			
Questionnaires : PSS, Ffmq, SCS, CNS.			
Blood samples Gene expression			
Heart Rate Variability			
IPA- interviews,½ hour			

Figure 5: Data collection (for each of the three groups, N=22)

Power calculation

Research in gene expression concerning stress has been conducted, but not to a sufficient level and not with corresponding target groups to make it possible to calculate average, variance components, and from that power.

An earlier study documented a link between mindfulness practice and change in the global transcription profile, in an 8-week mindfulness course for healthy adults (Dusek et al., 2008; Pallesen, Dahlgaard and Fjorback). Another study documented changes in a transcription profile consisting of histone deacetylase and protein inflammatory genes over a single day among trained mindfulness practitioners (Kaliman et al., 2014). This study is dimensioned in accordance with these investigations, including 66 participants, 22 in each group, whereas the mentioned study included 19 participants and 21 in the controlgroup.

Meditation has a documented effect on heart rate variability, HRV, (n = 7, Cysarz & Büssing, 2005; n = 22, Lehrer et al., 1999; n = 8+14+11+4+9, Peng et al, 1999; n = 10, Peng et al, 2004, n = 10+10 Wu & Lo, 2008). One study showed positive effects of mindfulness and HRV in a group of students (n= 506, Prazak et al., 2011).)

Regarding the IPA, 7 participants from each group have been interviewed. The number is a qualified estimate based on dialogues with experts.

Regarding the therapist factor, the teachers/therapists have been the same for the two groups, to avoid person bias in the treatments.

Participants and recruitment

A total of 66 (N) students have been recruited at universities and university colleges, supervised by managing staff members. Methods for recruitment include the use of intranet announcement, flyers, as well as referral by counselors.

Eligible students have been asked to participate in an information meeting and a following individual telephone assessment, conducted by a psychologist supervised by a psychiatrist. Students meeting all inclusion criteria were asked to participate in the randomized trial. After informed consent, participants were randomized to either ‘Mindfulness training in Nature’ (n= 7+15), ‘Mindfulness training Indoors’ (n= 9+13), or Controls, who did not receive any treatment before the end of trial (n=22). An independent statistician managed the randomization procedure.

Inclusion criteria

1. Active bachelor or master students from Danish universities and university colleges.
2. Self reported stress at the time of enrollment of the project, backed up by the results from Perceived Stress Scale and enrollment interview.

Exclusion criteria

1. Smoking

2. Known psychiatric diagnosis such as severe depression, severe anxiety, adjustment disorder, PTSD, personality disorder or psychosis
3. Autism or an untreated ADHD
4. Suicide risk
5. Addiction of e.g. alcohol or drugs

Limitations, outcomes and perspectives

Possible limitations:

The only possible time for the intervention was in August when it did not interfere with classes at the university colleges. As it is challenging to recruit during July, the time from enrollment until start of treatment was extended, and may have caused changes in stress level for the participants.

Participants are all students, and mostly young women. This will reduce generalizability.

Prior meditation experience may influence the treatment outcome. The participants are asked to describe prior meditation experience in the background questionnaire, but this data is not used in distribution of participants.

Dropout among control group participants: Participants in the control group will be offered a weekend mindfulness course. It may not be sufficient to prevent drop out, though.

Lastly, the program will in the first trial be taught by an American and a Dane, recruited as the best qualified for the job. Even though 1:1 translation of all dialogues has been offered, it has on few occasions resulted in some loss of nuances in the communication.

Perspectives

The findings in this project may contribute to a theoretical and practical clarification of whether and how nature based meditation can be one way to prevent and reduce stress and enhance attention restoration and mindfulness. If credibility is established, the next step could be investigating application of the tools, for example nature based mindfulness courses for students or health care providers. Another application that will probably come soon is 3D nature-based mindfulness short form intervention for stress prevention on workplaces, and for other purposes. For example for long-term patients or residents in hospices.

Ethics

The project has been approved by the Science Ethics Committee of the Region H and Science-Jur at Copenhagen University (protocol number 51986). Participants have been included after informed consent, and are free to leave the project or withdraw their consent at any time. No adverse effects are expected. Participants that are not considered eligible for the trial will be referred for other relevant treatments (e.g. psychiatric care), if relevant.

Time frame

Pre-project period January-May 2016: Approval from Science-Jur. and the Science Ethics Committee, Region H and enrollment at the PhD school of Science, University of Copenhagen.

Period 1 (June 2016 – December 2017): Recruiting of participants for trial 1 (2016) and trial 2 (2017) began April followed by interventions in August and data analysis in September – December. Paper 1 will be initiated during 4 months stay as a visiting scholar in the US.

Period 2 (January 2018 – February 2019): Papers will be written and submitted for publication.

Period 3 (February 2019 – August 2019): PhD thesis will be completed and submitted, and results mediated.

Communication and publications

Results from the PhD study will be published in peer-reviewed international journals. The PhD thesis is expected to result in an introduction part and 3 or 4 papers on the following topics/research questions:

1. Systematic literature review.
   Assessment of the evidence level of published litterature regarding the stress reducing effect and attention/mindfulness restoration of meditating in natural environments.
2. The impact on stress level when training mindfulness indoors compared with mindfulness training in nature.
3. The impact on mindfulness/attention level when training mindfulness indoor compared mindfulness training in nature.
4. The impact on stress relief when training nature-based mindfulness – a qualitative approach.

In addition to papers, findings will be communicated at oral and poster presentations at international and national conferences as well as in public lectures.