Smart-phone mindfulness based worry reduction intervention effects on individuals with Generalized Anxiety Disorder in a high work stress population.

Name: T.E.M. Angela

Student number: s2102099

Supervisor: Jos Brosschot

Leiden Institute of Psychology

Anxiety disorders are common and can have negative physical, personal, societal and occupational outcomes. Anxiety consists of constant negative thoughts and images. These negative thoughts can affect people in the workplace too. A new way of providing help to working participants with anxiety is the use of ecological momentary interventions (EMI). The purpose of this study is to investigate the effects of a smartphone mindfulness based worry reduction intervention on workers diagnosed with anxiety disorder in a high work stress population. A total number of 136 participants completed either the EMI mindfulness training or control condition lasting four weeks. These conditions were divided into participants with anxiety and those without. Those in the experimental condition received the mindfulness program, which focused on mindfulness techniques such as breathing and meditation, and those in the control condition simply registered their emotions. Using a repeated measures ANOVA, no significant reduction in worry was found for GAD participants versus non-GAD participants compared to the control group following the intervention. The non-significant results of this study can be attributed to many factors, including sample size and selection, definitions of anxiety or poor intervention format. Suggestions for future research include taking a closer look at anxiety and crafting a suitable intervention program for individual participants.

Introduction

Anxiety disorders are, next to depression, one of the most common mental disorders in the world. Anxiety disorders affect up to 29% of people worldwide (Firth, Torous, Nicholas, Carney, Rosenbaum & Sarris, 2017). The Netherlands Mental Health Survey and Incidence Study (NEMESIS) is a survey that estimates the lifetime prevalence of mental health disorders in the Netherlands (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). This survey indicated that the lifetime prevalence of mood disorders was 20.2% and the prevalence of anxiety disorders 19.6%. Major depression closely followed, with a prevalence of 18.7% (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). Generalized anxiety disorder (GAD) is classified in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5)(American Psychiatric Association, 2013) as having a persistent feeling of fear and worry about internal and external events, often accompanied by psychological and physiological complaints (Cuijpers, Sijbrandij, Koole, Huibers, Berking & Andersson, 2014). Anxiety disorders often have an early onset, meaning individuals in adolescent years and early adulthood are at most risk for developing an anxiety disorder (Kessler, Berglund, Demler, Jin, Merikangas & Walters, 2005). Individuals with childhood traumas and a low socio-economic status are also at a greater risk for developing anxiety disorders (Stein & Sareen, 2015). In the US, the prevalence of anxiety disorder is higher in women than in men (Stein & Sareen, 2015). Similar to the US, women in the Netherlands were more likely to be affected by mood disorders and anxiety disorders than men (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). However, comorbidity was high (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). Of those diagnosed with GAD, 46.4% were often diagnosed with two or more other disorders (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). Depression is often present and coexists with GAD, making it difficult to distinguish these two terms (Stein & Sareen, 2015). The difference between anxiety and depression lies in how patients

experience pleasure (Stein & Sareen, 2015). While both patients with depression and anxiety report similar feelings of hopelessness, patients with depression do not report experiencing pleasure in their daily lives (Stein & Sareen, 2015). This is not true for patients with anxiety, as they do report experiencing pleasure (Stein & Sareen, 2015).

A key aspect of GAD is worry or rumination (Vlemincx et al. 2013). Worrying is defined as having pervasive, intrusive and uncontrollable negative thoughts and images (Clancy, Prestwich, Caperon & Connor, 2016), which can lead to continued hypervigilance and hyperawareness. Perseverative cognition (PC) is a term introduced by Brosschot, Gerin and Thayer (2006) and it points to the negative psychophysiological effects worrying can have on an individual. In their article, Brosschot, Gerin and Thayer (2006) stated that worrying is the attempt of an individual to mentally solve a problem, often with little or no success. Here, worry serves three functions: alarming the individual, maintaining attention to the stressor and prepping the individual to act (Brosschot, Gerin & Thayer, 2006). However, the chance of the individual taking action is relatively small, leaving the individual in a constant state of preparation; even when the stressor is no longer present (Brosschot, Gerin & Thayer, 2006). In the perseverative cognition hypothesis (PCH), PC is defined as combination of worrying, rumination and other cognitive intrusions relating to stressors (Brosschot, Gerin & Thayer, 2006). However, there are differences between worrying and rumination. The definition of rumination is similar to worry in many literature, all having the common symptoms of persistent negative thought (Brosschot, Gerin & Thayer, 2006), but worry is often multifocal, meaning the individual worries about a variety of problems such as financial, social, family, future or work (Stein & Sareen, 2015). Rumination is further distinguished as the constant passive attention to symptoms of distress and the potential (negative) consequences these symptoms may bring forward (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008). The key difference between worry and rumination is that where worry

has been typically associated with anxiety disorders, rumination is typically associated with depressive disorders (Fresco, Frankel, Mennin, Turk & Heimberg, 2002). Worrying furthermore focuses on the future consequences of a mood state, whereas rumination focuses on the past and attributes this to current mood states (Carney, Harris, Moss & Edinger, 2010). Worrying and its persistent thinking can foster productive problem-solving strategies, however it often promotes the opposite (Brosschot, Gerin & Thayer, 2006). It may prolong negative effects for the individual (Brosschot, Gerin & Thayer, 2006). Individuals with GAD often have trouble controlling their worry and display symptoms of restlessness, irritability, muscle tension and increased probability of sleep disturbances (American Psychiatric Association, 2013; Goncalvez, & Byrne, 2012). Because of the constant state of worry, individuals with GAD are constantly trying to develop strategies that will minimize the worry (Eysenck, Santos, Derakshan & Calvo, 2007). Worrying can be seen as a perpetual tendency to solve a self-constructed mental stressor (Brosschot, Gerin & Thayer, 2006). The PCH states that worrying, and/or constant negative thought activates the stress-response known as "fight-or-flight" (Pascoe, 2017), prolongs this response and delays recovery (Clancy, Prestwich, Caperon & Connor, 2016). This continued activation of the stress response may lead to deceases relating to physical health (Clancy, Prestwich, Caperon & Connor, 2016). Individuals diagnosed with GAD were shown to have severe cognitive and physical impairments, similar to what can be found in patients with chronic medical conditions (Newman, Przeworski, Consoli & Taylor, 2014). Furthermore, those with GAD show severe decreased performance in cognitive demanding tasks (Eysenck, Santos, Derakshan & Calvo, 2007). Continued activation of this response is detrimental to health and is often mentioned as an underlying factor for mental disorders such as depression and anxiety disorders in general (Pascoe, 2017). Furthermore, excessive worrying can trigger the accompanying avoidance behavior of situations with low probability of threat and may further lead to the

adoption of ineffective coping strategies (Delgado et al. 2010). In sum, worrying can lead to many physical and mental complaints that are potentially dangerous for an individual.

Besides negative physical and cognitive consequences, anxiety disorders and its accompanying persistent worrying can have negative societal and occupational consequences. Societal consequences include the economic expense of treatment of such disorders (Zalta, 2011) while occupational consequences of anxiety disorders include, impairment in performance, a higher chance of work-related incidents and overall decreased job satisfaction (Weaver & Himle, 2017;Newbury-Birch & Kamali, 2001). In recent studies, psychosocial variables are shown to have negative effects on performance (Schell & Grasha, 2000). Psychosocial variables include relationships and personality traits. Research on the effects of these variables has consistently shown that high-anxious people performed poorly on different work performance and accuracy tasks, both under low- and under high stress conditions (Schell & Grasha, 2000). In recent years, anxiety has become a more common phenomenon in the workplace (Haslam, Atkinson, Brown & Haslam, 2005). Anxiety symptoms such as fatigue or low concentration, are shown to impair performance in the workplace (Haslam, Atkinson, Brown & Haslam, 2005) and increase the likelihood of accidents occurring in the workplace (Haslam, Atkinson, Brown & Haslam, 2005). Individuals with GAD perform worse at cognitively demanding tasks compared to healthy individuals (Eysenck, Santos, Derakshan & Calvo, 2007). This indicates that anxiety targets the efficiency of the cognitive processing of our working memory (Eysenck, Santos, Derakshan & Calvo, 2007). While many workers attribute their anxiety to poor managerial support, a larger number of workers blame the unmanageable amount of workload they receive on a daily basis for the anxiety they experience at work (Haslam, Atkinson, Brown & Haslam, 2005).

In the Effort-Reward (ERI) Imbalance model of work stress, which this study is based on, workers weigh their work efforts with their occupational gains (Williams, Dziurawiec & Heritage, 2017). These occupational gains can include salary, recognition or job security (de Jonge, Bosma, Peter & Siegrist, 2000). The ERI model is based on reciprocity, meaning that if there is a failed reciprocity between the employee's efforts and the occupational gains, employees will often experience emotional distress (Feuerhahn, Kühnel & Kudielka, 2012). It is argued here that experiencing high emotional distress due to a perceived ERI can lead to the development of GAD in workers. Persistent emotional distress accompanied with anxiety experienced by high work stress employees or emotional exhaustion can have adverse health consequences for employees on the long run. It can affect their psychological wellbeing and lead to burnouts, but similarly affect organizational outcomes such as performance, turnover intentions and absenteeism (Feuerhahn, Kühnel & Kudielka, 2012). Persistent exposure to high work stress can further have more implications for organizations. Organizations can lose significant amount of labor supply (Finnes, Ghaderi, Dahl, Nager & Enebrink, 2017). High work stress also impairs work functioning and is a predictor for future disability pension (Finnes, Ghaderi, Dahl, Nager & Enebrink, 2017). Besides organizational outcomes, employee well-being is also affected by anxiety caused by high work stress. According to the "happy-productive worker" theory, workers who experience more joy in their work tend to be more productive (Zelenski, Murphy & Jenkins, 2008). Experienced stress and anxiety in the workplace is shown to be negatively related to employee job satisfaction and general unhappiness (Rothmann, 2008). These in turn can affect job performance. In sum, anxiety and an unfair perception of effort and reward based on the ERI model can have severe occupational outcomes and can negatively affect employee mental health and well-being.

Interventions for anxiety are typically shown to be very successful, especially when done in the earlier stages of the development of the disorder (Martin, Sanderson, Cocker &

Hons, 2008). However, it is often observed that those affected by anxiety disorders usually do not seek immediate medical help. In fact, research shows that only 7% to 25% of individuals suffering from anxiety in industrialized countries receive treatment for their anxiety (Versluis et al. 2016). The workplace is argued to be a good area to target anxiety disorder since it provides a large portion of adult workers (Martin, Sanderson, Cocker & Hons, 2009). Furthermore, working is a part of an individual's daily routine. Therefore, it can be argued that interventions that take place in the workplace can reflect the daily routine of an individual better and have a greater effect than an intervention that takes place in the office of a therapist (Versluis et al. 2016).

With anxiety disorders potentially having such an impact at the workplace, employers and workers alike should implement preventative interventions. However, people with anxiety disorders seldom seek help (Goncalvez & Byrne, 2012) due to fear of labeling, the costs of seeing a therapist, or the lack of accessibility or availability of therapists (Weaver & Himle, 2017). Several forms of interventions have been used in treating GAD, such as pharmacotherapies (Cuijpers et al. 2014). Pharmacotherapies, such as selective serotonin-reuptake inhibitors (SSRI) and other antidepressants do show positive effects on feelings of anxiety in patients (Stein & Sareen, 2015). These drugs, although helpful, come with their side effects (Stein & Sareen, 2015). The current thought is that these drugs should be given in the case of failed therapy or in combination of therapy in severe cases (Stein & Sareen, 2015). The most dominant form of therapy now is the psychotherapy, the most well-known one being the cognitive behavioral therapy (CBT) (Weaver & Himle, 2017). As the name suggests, CBT uses a combination based on cognitive and behavioral strategies aimed to change thought processes and disadvantageous behavior (Weaver & Himle, 2017). It is a collaborative therapy form in which the patient and therapist actively set goals and identify problems and strategies to change behavior and thought patterns (Weaver & Himle, 2017).

This form of therapy has been linked to less patient relapse compared to medication (Omidi, Mohammadkhani, Mohammadi & Zargar, 2013). It has been consistently proven that CBT reduces symptoms of anxiety and worry in countless studies, ranging from small to large effect sizes (Zalta, 2010). This is the primary reason why CBT is the most common and trusted form of therapy for anxiety disorders and other forms of mental illnesses. Other forms of therapy typically used in reducing anxiety symptoms belong to the CBT family (Cijpers et al. 2014). These include emotion-focused therapy. Emotion-focused therapy is a contemporary CBT model that focusses on feelings of guilt, shame, stress and loneliness. It aims to develop self-treatment strategies for individuals to tackle accompanying emotional and cognitive avoidance (Timulak et al. 2017). These types of therapy are often done in face-to-face settings and include interaction between the therapist and the individual (Cijpers et al. 2014). Research by Timulak et al. (2017) showed that emotion-focused therapy was successful in reducing anxiety symptoms, with effect sizes similar to those of CBT. However, not all studies offer the same conclusion on this form of therapy and more research needs to be done (Finnes, Ghaderi & Dahl, 2017). Many studies include individuals with anxiety, but not all are caused by work-related situations (Finnes, Ghaderi & Dahl, Nager & Enebrink, 2017). Therefore, it is difficult to determine its effectiveness in a working routine. In a similar context, CBT is often an intense intervention that requires full commitment from the patient (Gratzer & Khalid-Khan, 2016). Not every working individual can or has the self-managing skill to commit to this form of therapy. It would be therefore beneficial to implement an intervention in the workplace that can raise the self-management skills of the employee while still being time- and cost efficient.

In recent years, a new form of therapy based on Eastern practices and Buddhism has emerged (Zhu, Hedman, Feng, Li & Osika, 2017). Mindfulness has become increasingly popular for mental disorders such as GAD, depression and chronic worriers (Lalande, King,

Bambling & Schweltzer, 2017). Mindfulness training focusses on the consciousness and awareness of cognitive, psychological and somatic sensations, being in the present, acknowledging thoughts as they pass by in a non-judgemental manner (Gu et al. 2015; Lalande, King, Bambling & Schweltzer, 2017). Mindfulness can be defined as a state of having a clear and vivid perspective of current experience (Omidi, Mohammadkhani, Mohammadi & Zargar, 2013). It aims to disengage individuals from automatic behaviors and from recurring thoughts (Omidi, Mohammadkhani, Mohammadi & Zargar, 2013). This intervention usually applies meditation and self-regulation of breathing (Lalande, King, Bambling & Schweltzer, 2017). Meditation is a popular method used by individuals in the health care services (Manocha, Sarris & Stough, 2011). Based on a survey in 2000, about 80% of health care professionals has recommended mediation to patients in their career (Manocha, Sarris & Stough, 2011). Being aware of ones breathing and consciousness is shown to activate the limbic system in the human brain associated with emotions (Lalande, King, Bambling & Schweltzer, 2017). Mindfulness is often combined with other forms of therapy, such as Mindfulness-Based Stress Reduction Therapy (MBSR), Mindfulness-Based Cognitive Therapy (MBCT) and Dialectical Behavioral Therapy (DBT) (Spijkerman, Pots & Bohlmeijer, 2016). These forms of therapies all incorporate and utilize the core concept of mindfulness, which is a state of awareness and the general acceptance of current experiences (Spijkerman, Pots & Bohlmeijer, 2016). Contrary to CBT and other forms of CBT, mindfulness focusses on being aware of- and changing the thoughts that occur, and not on the changing the content of the thought (Omidi, Mohammadkhani, Mohammadi & Zargar, 2013). The aim of mindfulness thus is to alter the individual's relation to thoughts and feelings, whereas CBT involves the restructuring of the cognition and beliefs previously held by the individual (Omidi, Mohammadkhani, Mohammadi & Zargar, 2013). As several research have shown, mindfulness has successfully reduced feelings of worry and anxiety after a three

month follow-up (Vleminx et al. 2013) and these positive results were maintained after a three year follow up (Delgado et al. 2010). Mindfulness therapy has further shown positive results in regards to reducing stress and feelings of anxiety in people following the therapy compared to a control group (Lalande, King, Bambling & Schweltzer, 2017). In general, mindfulness is shown to be positively correlated with life satisfaction and better interpersonal relationships, and negatively related to depression and anxiety (Dane & Brummel, 2013). Mindfulness is also proven to be related to overall better quality of life, in several clinical and non-clinical populations (Spijkerman, Pots & Bohlmeijer, 2016). To combat anxiety in the workplace, new interventions should be introduced at work, which combine mindfulness techniques. Studies on mindfulness show improvement in workplace performance (Dane & Brummel, 2013). In the study by Dane and Brummel (2013), they have found a positive relationship between mindfulness and job performance. They have also found that participants following mindfulness at work seemed to have significantly less turnover intentions compared to those not following mindfulness (Dane & Brummel, 2013). Mindfulness is thus shown to be effective in not only general everyday life context, but also effective in work-related contexts. However, working individuals often do not possess the time nor the will to fully commit to an intensive therapy program (Gratzer & Khalid-Khan, 2016). New interventions at the workplace combined with mindfulness techniques should focus on modern technology, which has a low threshold for participation, such as an ecological momentary intervention (EMI).

Since the beginning of the new century, the use of technology has become a more common occurrence. We have entered a digital era where countless applications are available on our phones or other devices. These applications are dedicated to a broad area, including mental health. Since September 2012, 6% of mobile apps were dedicated to mental health and around 18% of mobile apps were related to sleep, stress and relaxation (Donker, Petrie,

Proudfoot, Clarke, Birch & Christensen, 2013). A new policy has been recognized by the World Health Organization with concerning new interventions. This policy recognizes that new methods are needed to increase individual's self-management through means of electronic devices (Versluis et al. 2016). There has been an increase of internet-based interventions for depression and anxiety disorders over the last decade (Griffiths, Farrer & Christensen, 2010). People are turning more and more to technology to cope with stress, feelings of loneliness and isolation (Zhu et al. 2017). Psychological interventions are often unavailable to patients due to not being included in health care services, are costly or sometimes accessibility to a therapist's office can be problematic (Firth et al. 2017). Traditional forms of therapy are also limited in gathering data about the development of symptoms over time or across population (Torous, Staples & Onnela, 2015). Internet-based therapies offer innovative ways to deliver help to patients in a way that is cost-efficient, time efficient and can be easily done in a private setting (Newby et al. 2017). These forms of therapies also offer patients 24/7 service and anonymity (Spijkerman, Pots & Bohlmeijer, 2016). According to one study, 42% of individuals preferred the internet as an alternative way to deliver therapy, other than face-to-face interactions (Spijkerman, Pots & Bohlmeijer, 2016). An added benefit to internet-delivered therapies is the environment in which they take place. Psychologists argue that, skills learned in a traditional therapy setting may not translate in to daily life setting (Kalichman et al. 2002). Cues in our environment trigger old behavior, making it difficult for new learned behavior to transfer into our daily lives (Versluis, Verkuil, Spinhoven & Brosschot, 2018). These concerns regarding the limitation of data gathering and skill translation can easily be with EMI's. EMI's are ecological because of the natural environment in which they occur, and momentary because of the everyday situations they take place in (Heron & Smyth, 2010). These types of interventions can be available through mobile phones or tablets (Versluis, Verkuil, Spinhoven, van der Ploeg & Brosschot, 2016). In

recent studies, improvement rates of 40% to 60% have been found in patients following an internet-based intervention (Boettcher et al. 2014). Furthermore, doctors and psychologists can receive data about a patient's location through GPS, their activity level etcetera. These data are unparalleled and are often non -invasive for patients (Torous, Staples & Onnela, 2015). What this also implies is that these types of interventions using electronics or smartphones can be specific to that individual and can be implemented in their daily lives (Versluis et al. 2016). Internet delivered interventions have the added benefit that they can be available with or without the support of a therapist (Gratzer & Khalid-Khan, 2016). Because of this reduced or optional support of a therapist, it in turns reduces the waiting list of patients waiting for therapy. More patients can benefit from therapy and can get the help they need (Newman, Przeworski, Consoli & Taylor, 2014).

Positive effects have been found for patients following internet-delivered therapies. However, Internet-delivered therapy are not without fault. Problems with telecommunication can arise, such as internet connection, battery failure, or slow connectivity (Donker, Petrie, Proudfoot, Clarke, Birch & Christensen, 2013). Furthermore, texts on these apps often rely on webpage which is easier to read on a computer (Newman, Przworski, Consoli & Taylor, 2014). According to Newman, Przeworski, Consoli and Taylor (2014), therapy delivered through the internet does seem to be effective in reducing anxiety in their participants. However, this form of therapy did not seem to be superior to traditional forms of therapy such as CBT. Lastly, although internet and technology are currently accessible to a large number of people, not everyone can benefit from this. Individuals with low socio-economic status, seniors and individuals in rural areas may not have the luxury of having internet access or technology (Newman, Przeworski, Consoli & Taylor, 2014).

Most studies have examined the effects of computer delivered internet therapy, but the use of interventions delivered through mobile phones are increasing (Newman, Przworski,

Consoli & Taylor, 2014). This area of research is in its infancy; however, some research do offer positive and convincing results, despite its shortcomings. Psychological treatments administered using smartphones showed a significant reduction in anxiety symptoms compared to controlled conditions (Firth et al. 2017). More specifically, a study which administered an internet-based mindfulness program to individuals with anxiety and depression showed a significant decrease in symptoms of anxiety, compared to those who did not receive the program (Boettcher et al. 2014). With varying degrees of therapist support, it has been shown that internet-based therapy did decrease anxiety in patients, despite less support from a therapist (Gratzer & Khalid-Khan, 2016). Studies have shown a small to medium effect size for EMI's on anxiety (Versluis, Verkuil, Spinhoven, van der Ploeg & Brosschot, 2016). However, EMI's seem to be more effective in combination with a mindfulness program (Versluis et al. 2016). Therefore, it can be argued here that it would be more effective to combine these two types of interventions for the purpose of this study. In sum, research supports the idea that EMI's are successful in decreasing anxiety experienced by individuals. These positive findings can therefore be transferred to working settings. A mindfulness program administered through the internet can thus have positive results on individuals with anxiety in the workplace.

In a previous study by Versluis, Verkuil, Spinhoven and Brosschot, (2018) addressing the question of the effectiveness of an EMI in a sample of working individuals, Ambulatory Assessed Cardiac activity was used as a primary outcome measure, along with various other measurements. In this study however, these outcome measurements will not be used. Instead, the focus here will be on reducing worry in workers with a diagnosed anxiety disorder. The reason for choosing this variable is that the results presented in the previously mentioned study did not yield a significant interaction between the primary outcome (cardiac activity) and the intervention. Since the consequence of GAD is serious for workers and organizations

alike, it would be practical to investigate the legitimacy of the suspected interaction between GAD and worry in a working environment. Furthermore, the focus here will be only on worry and not on rumination, due to the stronger association between rumination and depression. With this information in mind, the following research question has been formulated. This report will tackle the question on the effects of a smart-phone mindfulness based worry-reduction intervention on people with Generalized Anxiety Disorder in a high work stress population. Specifically, the question here is: will a smart-phone based mindfulness worry reduction intervention lead to more decrease in worry in workers with a high score of GAD in a sample of high stress working population? The hypothesis therefore is: We expect a higher reduction in worry in workers with GAD scores of ten and above, after this smartphone-based mindfulness worry reduction intervention program.

Seeing the impact anxiety can have in the workplace and the increasing relevance of workers suffering from anxiety, organizational and other psychologists can benefit from this research question in many ways. Firstly, it can provide insights into different potential ways to treat people, and specifically employees, with anxiety disorders in a high stress-working environment. Secondly, interventions based on electronic mediums are becoming increasingly popular, and the results found here can offer more evidence on the effectiveness of such ecological momentary interventions. Societal consequences of these disorders are prevalent, and reducing the symptoms of worry in the workplace will not only reduce these negative societal consequences, but also reduce the health care costs, negative organizational outcomes and can promote self-management of individuals. Lastly, it can offer further implications for future research for health and organizational psychologists. It can serve as a guideline on how EMI's can be developed to cater to specific individual needs for treatments.

Method

Study Design

This research is based on a previous research done by Versluis, Verkuil, Spinhoven and Brosschot (2018) from September 14, 2014 until June 16, 2016. This study includes the same eligibility criteria for the participants, however, the focus of this study is on Dutch participants with a diagnosed GAD in a high work stress population. It is an experimental study with two groups, one experimental group and a control/ waitlist group. Furthermore, a distinction is made between two anxiety conditions. Workers, who are diagnosed with anxiety and workers who are not.

Participants

A randomized control trial was conducted in Dutch participants who experienced high work stress. Based on the power analysis done in the previous study by Versluis, Verkuil, Spinhoven and Brosschot (2018), a sample size of 136 participants was sufficient.

Participants were included if they were 18 years or older, not under any psychological treatments, were currently employed, were capable of operating a smartphone and experienced high work stress. Participants were excluded if they were currently undergoing psychological or psychiatric treatment, have or has had a history of cardiovascular decease, had a history of severe psychological disorder or abused substances. Furthermore, any participants who displayed suicidal tendencies were excluded and sent to a general practitioner. The ERI model mentioned in the introduction defined work stress. Participants completed the seven-item Generalized Anxiety Scale (GAD-7) that determined their levels of anxiety and to see if they were eligible to participate in the research. Participants were recruited at a health-care company, by means of advertisements in newspapers, newsletters from Leiden University or via local or national radio. The website http://www.piekeren.com

was then provided to participants where they received information and were able to complete the screening questionnaire. Eligible participants were then randomly allocated to either an experimental group or a control group/wait list. A total of 136 participants completed the questionnaire and test, about 74% of them were female with an estimated mean age of 43. Of those, 46 were in an experimental group and the remaining in a control/waitlist group. A total of 127 people completed the GAD-7 questionnaire. The number of people diagnosed with GAD (with a score of 10 or higher) was 13 participants and 114 were not. On average, 0.7% of participants completed only lower secondary education. Most participants completed either upper secondary education (27.9%) or first stage of tertiary education (65.4%). With regards of the ethnical background of the participants, the majority of participants were Dutch (89%). The rest of the population consisted of other ethnic groups such as participants from Suriname (0.7%) or other (4.4%).

Procedure

Interested participants who completed the online screening procedure were then contacted to inform them if they were included or excluded from the study. If participants were excluded, they would receive a notification and eligible participants received a phone call and were asked further questions. MovisensXS was offered to participants in both the CC and EC group as a smartphone application training in which emotion registration occurred. Participants had to rate their emotions on a scale from “not at all” to “very much”. After this, the participants in the EC group received a worry-reduction training. The CC group was simply told that describing and recognizing emotions would be enough to reduce stress.

A collaboration between well-trained psychologists and a mobile application company created a mobile app designed to provide online mindfulness training to participants, https://www.vgz.nl/mindfulness-coach-app. This mobile application was commissioned by the health insurance company VGZ and was named VGZ Mindfulness Coach Application.

The application contained three exercises: 1) breathing exercises, 2) body scans to allow participants to focus on bodily sensations while letting it pass by in an accepting and non-judgmental manner and 3) mindful-attention exercises to create in-the-moment feelings. Participants were free to choose which one of these exercises they would like to participate in day by day, but also had the option to allow the application to randomly select one exercise for them. The exercises ranged from 1 to 37 minutes, based on the preferences of the participants. It is thought that shorter mindfulness exercises were easier to implement in daily life and therefore more beneficial for individual in the long term than longer mindfulness exercises (Versluis, Verkuil, Spinhoven & Brosschot, 2018). The eligible participants were informed that the study would last four weeks, where they had to register their emotions five times a week for four weeks. They were also informed that three appointments would be scheduled during the first day, halfway through and on the last day of the four weeks. These appointments took place during the week, before 11:00 am. During these appointments, participants completed several assessments and no trainings were scheduled. The control group simply received the instruction to register their emotions daily.

The primary outcome that would be assessed is worry. This was done through the 16-item Penn State Worry Questionnaire (PSWQ). For anxiety, the Generalized Anxiety Disorder (GAD-7) questionnaire was used, with the cut-off point being a score of 10 (Spitzer, Kroenke,Williams & Löwe, 2006).

Primary outcome measurement

Worry: The primary outcome that will be assessed is worry. This will be done through the 16-item Penn State Worry Questionnaire (PSWQ). Each item is scored on a scale from 1, (“not like me”) to 5, (“very like me”). The higher the score on the PSWQ, the more indication of anxiety (Zhong, Wang, Li & Liu, 2009). The internal consistency and test-retest reliability of the PSWQ is considered good (Zhong, Wang, Li & Liu, 2009).

Measuring instrument

Anxiety: For anxiety, the Generalized Anxiety Disorder (GAD-7) questionnaire was used, with the cut-off point being a score of 10 (Spitzer, Kroenke,Williams & Löwe, 2006). A score lower than a 10 will indicate mild anxiety while a score of 10 or higher will indicate severe anxiety. A score of 10 was chosen as a cut-off point because of its increased specificity (88%) and sensitivity (68%) for anxiety disorders (Spitzer, Kroenke, Williams & Löwe, 2006).

Effort-Reward Imbalance (ERI): The ERI model defined work stress. A high effort and low reward indicated an imbalance, where participants are considered experiencing high work stress. This was measured through the Effort-Reward Imbalance Questionnaire. In the study by Versluis et al. (2017), a cut-off score of greater than 1.00 was used. In this study, the same cut-off point will be used. A score greater than 1.00 indicated serious adverse health effects (Siegried, 2010).

Mindfulness: Lastly, the self-report 39-item Five facet Mindfulness Questionnaire (FFMQ) was then further used to assess someone's mindfulness tendency in their daily lives. It is based on five factors that represent elements of mindfulness (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006). The outcome measure is the sum of the scores on the items. The (convergent) validity and internal consistency of these tests are considered to be good (Goldberg et al., 2016; de Bruin, Topper, Muskens, Bögel & Kamphuis, 2012).

Statistical Analysis

First, descriptive statistics of the study sample will be provided. The age, gender, nationality and education level of the participants will be explored. The scores of the participants on the ERI- questionnaire, PSWQ and GAD-7 will also be examined. Control analysis will be performed using a correlation analysis to see if a correlation exists between

GAD-7 scores and the participant's scores on the PSWQ. One-way ANOVA's will be computed to control for any differences between the conditions and certain variables. These variables include age, ERI-ratio and the results on the GAD-7. A chi-square test will furthermore be conducted to control for any differences between condition, gender and the grouping of workers with and without GAD, which will be labeled as GADgroup. This group is divided in two conditions, one with a score lower than 10 (workers not diagnosed with GAD) and one with a score of 10 and up (workers diagnosed with GAD). Additional chi-squares tests will be conducted for the variables ethnicity and educational level. Any significant differences between condition and these variables (gender, age, GAD-7, PSWQ, ERI, ethnicity and education) will be added to the second statistical analysis of the repeated measures ANOVA as a covariate.

After conducting the above-mentioned control statistics for the descriptive statistics, a repeated measures ANOVA will then be used to assess the differences between participants worry levels, condition and GADgroup. Here, the dependent variable will be worry, measured by the PSWQ. The independent variables are the smartphone intervention and the GAD condition. Lastly, after the repeated measures ANOVA is conducted and the results examined, an additional repeated measures ANOVA will be conducted to see if any covariates have an effect on the results. A standard p-value of $p < .05$ will indicate a significant difference. The statistical tests will be performed through the program SPSS.

Results

A repeated measures ANOVA was conducted to compare the effects of a smartphone based worry reduction intervention on workers with GAD in a high stress working population, measured at three time intervals.

Descriptive Statistics

A total number of 136 subjects participated in this experimental study. Of those, *n*= 46 participants were randomly assigned to the experimental condition and *n*=90 participants in the waitlist/control condition.

In percentages, 10.2% of the sample was diagnosed with GAD and 89. 8% did not meet the criteria to be diagnosed with GAD. For gender, *n*=96 participants were female and *n*=40 were male. On average, 8% of females were diagnosed with anxiety, while 15.4% of males were diagnosed with anxiety. This trend per gender is different than what is normally observed in the US (Stein & Sareen, 2010) and in the Netherlands (de Graaf, ten Have, van Gool & van Dorsselaer, 2010). GAD is more frequently present in women (5.4%) than in men (3.6%). The average age for participants was 43 years old (*SD* =11.39), as seen in Table 1.

Table 1

Descriptive Statistics for Population

		Age	ERI	PSWQ	GAD-7
N	Valid	136	136	127	127
	Missing	0	0	9	9
M		43.23	1.18	51.49	5.65
SD		11.39	.20	10.28	3.16

Note: Values for ERI, PSWQ and GAD-7 are at baseline.

In Table 1, the descriptive statistics for the ERI, PSWQ and GAD-7 can be seen. For the ERI-questionnaire, the average mean was *M*=1.18, with a standard deviation of *SD*=.20.

This means participants feel an effort-reward imbalance that is higher than typically observed in the normal population (Siegrist et al. 2004). In non-clinical populations, the average ERI-questionnaire score is usually M=0.93 (SD=.30), both for men and for women (Steptoe, Siegrist, Kirschbaum & Marmot, 2004). An average mean of M=52.49 (SD=10.28) was observed at baseline for the PSWQ (see Table 3) and a mean of M=51.49 (SD=10.28) was observed for overall PSWQ (Table 1). This indicated a higher level of worrying for participants, compared to the normal population (Behar, Alcaine, Zuellig & Borkovec, 2003). For non-clinical populations, an average PSWQ score of M=32.89 (SD=9.17) is usually observed (Wuthrich, Johnco & Knight, 2014). A reduction in PSWQ total means for condition and GADgroup means can be seen in Table 3. It is also important to note and a reduction in PSWQ scores can also be observed for participants in the control/waitlist group. For the GAD-7, an average score of M=5.65 (SD= 3.16) was observed. This is somewhat different than what is normally observed in the population, M=14.4, SD=4 (Donker, van Straten, Marks & Cuijpers, 2011).

Control Analysis

Firstly, a correlation analysis was conducted to assess the relationship between the PSWQ test and GAD-7 test, illustrated by Table 2. There was a positive correlation between the GAD-7 and the PSWQ, Pearson r=0.48, n=127, p< .01 meaning anxiety diagnoses is weakly associated with worrying.

Table 2

Correlations Between PSWQ and GAD

		PSWQ	GAD-7
PSWQ	Pearson Correlation	1	.48**
	Sig. (2-tailed)		.00
	N	127	127
GAD-7	Pearson Correlation	.48**	1
	Sig. (2-tailed)	.00	
	N	127	127

Note: Correlation between PSWQ and GAD-7 taken at baseline, *= $p \leq .01$ will indicate significance

Five chi-square tests of independence were performed to control for any unwanted significant associations between the conditions and certain variables. The first test examined the association between condition (0=waitlist and 1= experimental) and gender (0=male and 1=female). The second test explored the association between condition and GAD (1= no GAD and 2= GAD). No significant association were found for condition and gender, $\chi 2$ (1) =1.01, p=.31. Similarly, no significant association was found between the variables condition and workers with or without GAD, $\chi 2$ (1) =.85, p=.36. This means that the conditions were not significantly associated with gender or GAD conditions. A third chi-square test was computed to examine the association between gender and workers with or without GAD. Again, no significant association was found between these two variables, $\chi 2$ (1) =1.62, p=.20,

meaning GAD was not associated with gender. The fourth test examined the association between condition and the level of education of the participants. No significant association was found between these two variables, $\chi 2$ (2) =.75, p=.69. Lastly, a chi-squared test showed no association between condition and the ethnicity of participants, $\chi 2$ (2) =1.19, p=.55. The ethnicity and educational levels of participants were not significantly associated with condition.

After running a one-way ANOVA to test differences between conditions on age, ERI and scores on the GAD-7, a significant difference was found for condition and age, F (1.13) =5.62, p<.01. The age of the participants significantly interacted with the condition. Therefore, age was taken in to the second repeated measures ANOVA analysis as a covariate. No other significant differences were found between condition and ERI or on the GAD-7 after running the one-way ANOVA.

Test of the Hypothesis

The means and standard deviations of the dependent variable worry split up per condition and GADgroup can be seen in Table 3. The total mean for the dependent variable at T1 is M=52.78, SD=10.15. The total mean for the dependent variable for time three is M=49.94, SD=10.21. This is a reduction in the average mean over time for the worry levels of participants. Looking more specifically at the participants with GAD in the experimental condition, a reduction in the average mean can also be observed: The average mean for participants in the experimental group with diagnosable GAD at T1 was M=59 (SD=8.98), for T2 it was reduced to M=56.50 (SD=9.47) and finally for T3, it was M=51.75 (SD=5.25). To test whether the decrease in worry is higher in the experimental condition, and within that group, for the GAD group, a repeated measures ANOVA will be computed next to see if this three-way interaction is significantly different.

Table 3

Mean and Standard Deviation of Time, GAD and Condition

	Condition	Gadgroep	*M*	*SD*	*N*
Total score on Penn State Worry Questionnaire at T1 (sum of all items)	waitlist and control condition	1.00	51.75	10.36	67
		2.00	59.17	11.87	6
		Total	52.36	10.6	73
	experimental condition	1.00	52.97	9.22	32
		2.00	59.00	8.98	4
		Total	53.64	9.27	36
	Total	1.00	52.14	9.97	99
		2.00	59.10	10.26	10
		Total	52.78	10.15	109
Total score on Penn State Worry Questionnaire at T2 (sum of all items)	waitlist and control condition	1.00	51.25	10.86	67
		2.00	55.50	12.94	6
		Total	51.60	11	73
	experimental condition	1.00	51.78	9.77	32
		2.00	56.50	9.47	4
		Total	52.31	9.72	36
	Total	1.00	51.42	10.47	99
		2.00	55.90	11.10	10
		Total	51.83	10.56	109
Total score on Penn State Worry Questionnaire at T3 (sum of all items)	waitlist and control condition	1.00	49.82	10.72	67
		2.00	51.00	17.04	6
		Total	49.92	11.21	73
	experimental condition	1.00	49.75	8.25	32
		2.00	51.75	5.25	4
		Total	49.97	7.94	36
	Total	1.00	49.80	9.95	99
		2.00	51.30	13.06	10
		Total	49.94	10.21	109

Note: Average mean for PSWQ for time 1 to time 3 has decreased, in the experimental and waitlist condition.

For the hypothesis test, a Mauchly's test of, $\chi 2$ (7.15), $p<.01$ did indicate a violation of sphericity (Table 4), therefore the Huyhn-Feldt results will be used to correct the degrees of freedom.

Table 4

Mauchly's Test of Sphericity

					Epsilon[b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	*df*	*Sig.*	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.93	7.14	2	.03	.94	.98	.50

Note: Significant indicates a violation of Sphericity

The repeated measures ANOVA results can be seen in Table 5 below. A significant main effect for Time was found, F (1.96,206.13) =14.72, $p<.01$. The worrying levels of the participants significantly differed over time. A significant interaction was found for Time X GADgroup. F (1.96,206.13) =3.63, $p<.01$. Worrying in the GAD group showed more decrease than those in the no GAD group over time. No significant differences were found for the three-way interaction in time between condition and GADgroup, F (1.96,206.13) =.19, $p=.82$ (Condition X GADgroup X Time). This means that, the intervention did not have a significant effect on participants with GAD over time as opposed to the no- GAD participants.

Table 5

Repeated Measures ANOVA on the effect of Time, Condition and GADgroup and their interaction

Source		Type III *SS*	*df*	*MS*	*F*	Sig.
Time	Sphericity Assumed	465.22	2	232.61	14.72	.00
	Greenhouse-Geisser	465.22	1.88	248.03	14.72	.00
	Huynh-Feldt	465.22	1.96	236.98	14.72	.00
	Lower-bound	465.22	1.00	465.22	14.72	.00
Time * condition2	Sphericity Assumed	.78	2	.39	.03	.98
	Greenhouse-Geisser	.78	1.88	.42	.03	.97
	Huynh-Feldt	.78	1.96	.39	.03	.97
	Lower-bound	.78	1.00	.78	.03	.88
Time * Gadgroep	Sphericity Assumed	114.61	2	57.30	3.63	.03
	Greenhouse-Geisser	114.61	1.88	61.10	3.63	.03
	Huynh-Feldt	114.61	1.96	58.38	3.63	.03
	Lower-bound	114.61	1.00	114.61	3.63	.06
Time * condition2 * Gadgroep	Sphericity Assumed	6.10	2	3.05	.19	.83
	Greenhouse-Geisser	6.10	1.88	3.25	.19	.81
	Huynh-Feldt	6.10	1.96	3.11	.19	.82
	Lower-bound	6.10	1.00	6.10	.19	.66

Error(Time)	Sphericity Assumed	3318.43	210	15.80
	Greenhouse-Geisser	3318.43	196.94	16.85
	Huynh-Feldt	3318.43	206.13	16.09
	Lower-bound	3318.43	105.00	31.60

Next, since age was found to be significantly different across conditions, age was taken as a covariate for the next repeated measures ANOVA. After including age as the covariate, one major change in the results of the repeated measures ANOVA was found. The strong significant main difference effect for Time in the initial ANOVA was no longer observed, $F(1.98,206.02) = 2.67$, $p = .07$. The level of worrying of the participants did not significantly differ over time. For the remaining differences, not much has changed with the inclusion of the covariate. No significant differences were found for the interaction of Age X Time, $F(1.98,206.02) = .14$, $p = .87$. Importantly highlighting that the smart-phone intervention did not have a significant effect over time for the conditions and GADgroups.

Discussion

The question that was examined here was whether a smartphone mindfulness based worry reduction program decreases worry in workers with diagnosable GAD in a high stress working population. A previous study by Versluis, Verkuil, Spinhoven and Brosschot (2018) yielded no significant positive effect of a worry-based EMI intervention on ambulatory assessed cardiac activity in high work stress population. Akin to the results of Versluis,

Verkuil, Spinhoven and Brosschot (2018), this study did not find the three-way interaction of time, condition and GADgroup stated in the hypothesis. Compared to the control group, no significant reduction in worry was found for GAD participants versus non-GAD participants following the intervention, failing to reject the null hypothesis. The factor Time did have a positive effect by lowering worry levels of participants in the initial analysis, but after the inclusion of the covariate age, this significant effect disappeared. Time no longer significantly decreased worrying levels of participants. A significant difference was found for worrying in workers in the GADgroup. Worrying did significantly decrease in workers in the GAD condition. However, the effect size of this difference was relatively small, meaning the passage of time did not necessarily lead to a meaningful decrease in worrying in this group. Only age was used as a covariate. After examining the differences with a one-way ANOVA between condition and participants scores on the GAD-7, FFMQ, ERI-questionnaire and age, only age was found to be significant and was thus taken in to the analysis as a covariate. The age of the participants was therefore controlled for. Level of education, nationality and gender did not differ between conditions, as indicated by the chi-square tests of independence performed, and thus were not taken in to the analysis.

These results are mostly not in line with most research on the effects of EMI's on symptoms of anxiety. This study did not indicate a significant reduction in worry for participants in the experimental or control condition with anxiety, contrary to most research findings. Smartphone interventions do seem to have a positive effect on reducing symptoms of anxiety compared to control conditions (Firth et al. 2017; Cavanagh et al. 2013). Mindfulness delivered through electronic devices is shown to reduce anxiety symptoms, including worry, in participants following such therapies, with mostly small effect sizes (Cavanagh et al. 2013). Similar results were found by Versluis et al. (2016), with EMI's having a positive effect on anxiety, but the overall quality of the assessments were weak.

Firth et al. (2017) also found small to medium effect sizes of a smartphone delivered therapy to patients with diagnosed anxiety. In contrast, a randomized control trial by Boettcher et al. (2014) found that a stand-alone internet delivered mindfulness program decreased symptoms of anxiety in participants, with fairly large effect sizes. All these researches do indicate that internet-delivered therapies are a good supplement for therapy for individuals with anxiety, but their effects are mostly relatively small to medium.

Limitations

This study includes several limitations that could have had an effect on the results. The difference between this study and these results may be found in the definition of anxiety and its symptoms. While this study uses the DSM-5 definition of anxiety, other definitions of anxiety may be used. For example, the study of Newman, Przeworski, Consoli and Taylor (2014) used the definition of anxiety presented in the DSM-4. It is possible that these subtle changes in definition and grouping of GAD could have impacted the results. These changes in definition of GAD could have made the criteria for diagnosing someone with GAD more or less sensitive. In such cases, more people could have been diagnosed with GAD while not having GAD. It could have also excluded participants who did have anxiety because of its sensitivity. Secondly, this study acknowledges that anxiety and depression coexist and are often difficult to separate (Stein & Sareen, 2015) and chose to focus specifically on anxiety. It is possible that a different result would be obtained without the distinction of these two mental disorders. To illustrate this point, the study of Cavanagh et al. (2013) grouped anxiety and depression together by using the Patient Health Questionnaire for Depression and Anxiety (PHQ-4). This grouping could have explained the positive effect of online mindfulness Cavanagh et al. (2013) have found in their study. Secondly, the eligibility criteria for this study specifically did not include participants with a history of mental illnesses nor participants who were currently undergoing psychological treatment. In the

study by Firth et al. (2017), they did not exclude such participants. The use of medication could have positively affected the positive results found in the study of Firth et al. (2017) and could be an explanation for the differences in results. Furthermore, this article focusses specifically on worry, by using the PSWQ, rather than anxiety as a whole. Many researches about anxiety has not specifically stated that they will solely focus on the worrying aspect of anxiety. Many studies did not separate worry and only used measurements of anxiety, such as the Anxiety Sensitivity Index (ASI) (Lalande, King, Bambling & Schweltzer, 2017) or the Hamilton Anxiety Rating Scale (Newman, Przeworski, Consoli & Taylor, 2014). These measurements measured the majority of anxiety symptoms. Taking only one aspect of anxiety may have had an impact on the results of this study. Choosing to focus only on worrying may have left other aspects aside and may have accounted for the non-significant interaction between the variables and therefore the difference between the results of this study and results of previous studies.

The level of mindfulness of participants were not recorded before, during or after the intervention. If the mindfulness skills of participants differed between participants before the intervention, it could have been tested whether this had a moderating effect on the effectiveness of the intervention. Those who have previously practiced or have been aware of mindfulness could have benefitted more from these trainings than those who did not previously practiced mindfulness, as they are aware the proper techniques used for mindfulness and could have been aware of the health benefits. On the other hand, those who were not aware of mindfulness could have also benefitted more from these mindfulness trainings because, unlike those who previously practiced mindfulness, habituation did not yet occur. Another potential factor contributing to the ineffectiveness of the smartphone intervention could be attributed to the length of these mindfulness sessions. A short mindfulness program was argued here to be sufficient, however this claim could have been

false in this situation. A last contributing factor here for the non-significant effect of the interaction could have been the choice the participants had with the mindfulness program. The choice mentioned here points to the fact that participants were able to choose which program they wanted to do. This could also change during the four weeks-meaning participants could switch between mindfulness-program freely and as frequently as they like. This could have proposed a variability problem in the way mindfulness training was delivered to the participants, in both length and type of training. This variability could have made the learning process difficult for the participants. A more structured approach to mindfulness training could have potentially facilitated the uptake of mindfulness skills in participants. While flexibility of a training is essential, future research should focus at least on specifying the duration of an intervention. Lastly, this study did not have a follow-up measurement

Not only differences in the definition of anxiety or the length of the intervention could have had an impact on the non-significant results, but also the sample itself could have had an impact. For starters, the distribution of participants in this study appeared to be problematic. Those who were diagnosed with GAD in this study (with a score of 10 or higher) was less numerous than those without GAD. Only about 10% of the sample population were sorted in to the GAD condition. These could have affected the results. Small sample sizes increase the probability of type 2 error, failing to reject the null hypothesis, a false negative (Faber & Fonseca, 2014). Studies show that as a small sample size, the uncertainty of the estimates increases. Therefore, as the variability of sample increases, the precision or confidence level of this study decreases. The prevalence of anxiety disorder between men and women were also not according to literature. Here, men experienced anxiety more than women, 8% for males and 15.4% for females. The opposite is normally observed (Kessler et al. 1994). This overrepresentation of men with anxiety and underrepresentation of women with anxiety in

this study is a form of sample selection bias and can have an effect on the external validity of this study. It may affect the representability and generalizability of this study. This study may not be representative for the overall population and it may not serve as an accurate distribution of the prevalence of anxiety between women and men.

Implications

While the mindfulness based smartphone intervention did not significantly decrease worry in participants in the experimental/waitlist conditions with GAD over time, some conclusions can still be made about this study. The fact that the effect of time did significantly differ for the GAD condition does imply a positive silver lining for EMI's. While more research is needed, it can be said that EMI's can have a positive effect on anxiety, as illustrated by previous studies. Suggestions for future research may include a closer look at anxiety as a whole. Researchers should look at the different aspects of anxiety, not just worry or rumination. Researchers should also control for the presence of depression in patients, as depression often coexists with anxiety. The intervention in its current state and format was shown to be ineffective, however this can be improved in future studies. Future researchers should also keep in mind that mindfulness skills of participants can potentially affect outcomes of interventions. Thus, the mindfulness skills of participants must be measured before the intervention. Mindfulness is shown to be effective, but not in combination with a smartphone based EMI's. A different form of mindfulness, such as cognitive-based mindfulness in combination with EMI's could be a studied. Another form of EMI's could be used to deliver therapy to participants. With so many media forms, researches could include not only smartphones, but also tablets, computers or smartwatches in their study. More than one form of EMI can be used to administer interventions. Researchers should also tailor the interventions more to the individual and their needs. Depending on the individual's situation, the length and content of the mindfulness intervention should be longer

or shorter and include more or less breathing exercises. Based on the mindfulness skills of the individual, future EMI-based mindfulness intervention should include a beginner, intermediate or advanced mindfulness intervention. Researchers could also consider using social media to introduce or train participants in therapy. In the article by Versluis et al. (2016), they've implied that the effectiveness of EMI's increased in combination with a mental health professional. Researchers may also want to include support from face-to-face interactions between patients and trained psychologists. What these studies suggest is that therapy delivered through EMI's can add value to traditional therapies. Rather than replacing traditional forms of therapy, EMI's can act as an added support to mental health care professionals and not as a replacement. Furthermore, future methodology must be corrected and adapted. Researchers should focus on obtaining an equal distribution of participants in the sample and must avoid sample selection bias. Researchers should aim to raise their external validity by ensuring the prevalence of anxiety in males and females in their sample are similar to the prevalence of anxiety of males and females in the general population. Lastly, researchers should always have a follow-up measurement, preferably one three months after the intervention, and one six months after the intervention has taken place.

Conclusion

To conclude, the effect of a smart-phone based mindfulness worry reduction intervention on participants with GAD in a high work stress population proved not to be effective in reducing feelings of worrying in participants. Some significant differences were found between time and anxiety, meaning potential future implications on mindfulness EMI's and anxiety. Finally, EMI's are a new and interesting way to provide psychological help for patients with anxiety, with many benefits and positive results. This study, in combination with comparable ones, suggests that EMI's should not replace a therapist, but rather, it cannot be excluded and it could added as an additional support for both the therapist and the patient.

References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using selfreport assessment methods to explore facets of mindfulness. *Assessment, 13*, 27- 45, retrieved from: https://www.ncbi.nlm.nih.gov/pubmed/16443717

Behar E, Alcaine O, Zuellig AR, Borkovec T. (2003). Screening for generalized anxiety disorder using the Penn State Worry Questionnaire: A receiver operating characteristic analysis. *Journal of Behavior Therapy and Experimental Psychiatry,33,* 25-43, retrieved from https://www.ncbi.nlm.nih.gov/pubmed/12763391

Boettcher, J., Astrom, V., Pahlsson, D., Schenstrom, O., Andersson, G. & Carlbring, P. (2014). Internet-based mindfulness treatment for anxiety disorders: A randomized controlled trial, *Behavior Therapy*, *45*, 241-253, doi: 0005-7894/45/241-253

Brosshot, J.F., Gerin, W. & Thayer, J.F. (2006). The preservative cognition hypothesis: A review of worry, prolonged stress-related physiological activation and health, *Journal of Psychosomatic Research, 60,* 113-124, doi: 10.1016/j.jpsychores.2005.06.074

de Bruin, E.I., Topper, M., Muskens, J.G.A.M., Bögels, S.M. & Kamphuis, J.H. (2012). Psychometric properties of the Five Facets Mindfulness Questionnaire (FFMQ) in a meditating and non-meditating sample, *Sage Journals , 19*(2), 187-197, doi: https://doi.org/10.1177/1073191112446654

Carney, C. E., Harris, A. L., Moss, T. G., & Edinger, J. D. (2010). Distinguishing Rumination from Worry in Clinical Insomnia. *Behaviour Research and Therapy*, *48*(6), 540–546. http://doi.org/10.1016/j.brat.2010.03.004

Clancy, Prestwich, Caperon & Connor (2016). Perseverative cognition and health behaviors: A systematic review and meta-analysis, *Frontiers in Human Neuroscience, 10*, 534, doi: https://doi.org/10.3389/fnhum.2016.00534

Cuijpers, P., Sijbrandij, M., Koole, S., Huibers, M., Berking, M. & Andersson, G. (2014). Psychological treatment of generalized anxiety disorder: A meta-analysis, *Clinical Psychology Review, 34*, 130-140, doi: http://dx.doi.org/10.1016/j.cpr.2014.01.002

Dane, E. & Brummel, B.J. (2013). Examining workplace mindfulness and its relations to job performance and turnover intentions, *Human Relations, 67*(1), 105-128, doi: 10.1177/0018726713487753

Demerouti, E., Nachreiner, F., Bakker, A.B. & Schaufeli, W.B. (2001). The job demands-resources model of burnout, *Journal of Applied Psychology, 86*(3), 499-512, doi: 10.1037//0021-9010.86.3.499

Delgado, L.M., Guerra, P., Perakakis, P., Nieves Vera, M., Reyes del Paso, G. &Vila, J. (2010). Treating chronic worry: Psychological and physiological effects of a training programme based on mindfulness, *Behavior Research and Therapy, 48*, 873-882, doi: 10.1016/j.brat.2010.05.012

Donker, T., van Straten, A., Marks, I. & Cuijpers, P. (2011). Quick and easy self-rating of Generalized Anxiety Disorder: Validity of the Dutch web-based GAD-7, GAD-2 and GAD-SI, *Psychiatry Research, 188,* 58-64, doi: 10.1016/j.psychres.2011.01.016

Donker, T., Petrie, K., Proudfoot, J., Clarke, J., Birch, M.-R., & Christensen, H. (2013). Smartphones for Smarter Delivery of Mental Health Programs: A Systematic Review. *Journal of Medical Internet Research, 15*(11), e247. http://doi.org/10.2196/jmir.2791

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*(2), 336-353 doi: http://dx.doi.org/10.1037/1528-3542.7.2.336

Faber, J. & Fonseca, L.M. (2004). How sample size influences research outcomes, *Dental Press J Orthod, 19*(4), 27-29, doi: 10.1590/2176-9451.19.4.027-029.ebo

Finnes, A., Ghaderi, A., Dahl, J., Nager, A., & Enebrink, P. (2017). Randomized controlled trial of acceptance and commitment therapy and a workplace intervention for sickness absence due to mental disorders. *Journal of Occupational Health Psychology*. http://dx.doi.org/10.1037/ocp0000097

Firth, J., Torous, J., Nicholas, J., Carney, R., Rosenbaum, S. & Sarris, J. (2017). Can smartphone mental health interventions reduce symptoms of anxiety? A meta-analysis of randomized controlled trials, *Journal of Affective Disorders, 218,* 15-22, doi: http://dx.doi.org/10.1016/j.jad.2017.04.046

Feuerhahn, N., Kühnel, J. & Kudielka, B.M. (2012). Interaction effects of effort-reward imbalance and overcommitment on emotional exhaustion and job performance, *International Journal of Stress Management, 19*(2), 105-131, doi: 10.1037/a002833

French, D.P. & Sutton, S. (2010). Reactivity of measurement in health psychology: How much of a problem is it? What can be done about it? *The British Psychological Society, 15*(3), 453-468, doi: https://doi.org/10.1348/135910710X492341

Fresco, D.M., Frankel, A.N., Mennin, D.S., Turk, C. L. & Heimberg, R.G. (2002). Distinct and overlapping features of rumination and worry: The relationship of cognitive production to negative affective states, *Cognitive Therapy and Research, 26*(2), 179-188, doi: https://doi.org/10.1023/A:1014517718949

Goldberg, S. B., Wielgosz, J., Dahl, C., Schuyler, B., MacCoon, D. S., Rosenkranz, M., … Davidson, R. J. (2016). Does the Five Facet Mindfulness Questionnaire measure what we think it does? Construct validity evidence from an active controlled randomized clinical trial. *Psychological Assessment*, *28*(8), 1009–1014, http://doi.org/10.1037/pas0000233

Gonçalves, D.C. & Byrne, G.J. (2012). Interventions for generalized anxiety disorder in older adults: Systematic review and meta-analysis, *Journal of Anxiety Disorders, 26,* 1-11, doi: 10.1016/j.janxdis.2011.08.010

de Graaf, R., ten Have, M., van Gool, C. & van Dorsselaer, S. (2010). Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2, *Soc Pschyiat Epidemiol,19*(3), 125-141, doi: 10.1007/s00127-010-0334-8

Gratzer, D., & Khalid-Khan, F. (2016). Internet-delivered cognitive behavioural therapy in the treatment of psychiatric illness. *CMAJ : Canadian Medical Association Journal*, *188*(4), 263–272. http://doi.org/10.1503/cmaj.150007

Griffiths, K.M, Farrer, L. & Christensen, H. (2010). The efficacy of internet interventions for depression and anxiety disorders: A review of randomized controlled trials, *MJA, 192*(11)

Gu, J., Strauss, C., Bond, R. & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis mediation studies, *Clinical Psychology Review, 37,* 1-12, doi: http://dx.doi.org/10.1016/j.cpr.2015.01.006

Haslam, C., Atkinson, S., Brown, S.S. & Haslam, R.A. (2005). Anxiety and depression in the workplace: Effects on the individual and organization (a focus group investigation), *Journal of Affective Disorders, 88,* 209-215, doi: 10.1016/j.jad.2005.07.00

Heron, K. E., & Smyth, J. M. (2010). Ecological Momentary Interventions: Incorporating Mobile Technology Into Psychosocial and Health Behavior Treatments. *British Journal of Health Psychology*, *15*(Pt 1), 1–39, http://doi.org/10.1348/135910709X466063

de Jonge, J., Bosma, H., Peter, R. & Siegrist, J. (2000). Job strain, effort-reward imbalance and employee well-being: A large-scale cross-sectional study, *Social Science and Medicine, 50,* 1317-1327, retrieved from: www.elsevier.com/locate/socscimed

Kalichman, S., Stein, J. A., Malow, R., Averhart, C., Dévieux, J., Jennings, T., … Feaster, D. J. (2002). Predicting protected sexual behaviour using the information-motivation-behaviour skills model among adolescent substance abusers in court-ordered treatment. *Psychology, Health & Medicine, 7*, 327–338. doi: 10.1080/13548500220139368

Kessler, R.C., Berglund P., Demler O., Jin R., Merikangas, K.R. & Walters, E.E. (2005). Lifetime Prevalence and Age-of-Onset Distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry.62*(6):593–602. doi:10.1001/archpsyc.62.6.59

Kessler, R.C., McGonagle, K.A., Zhao, S., Nelson, C.B., Hughes, M., Eshleman, S., Wittchen, H.U. & Kendler, K.S. (1994). Lifetime and 12-Month Prevalence of DSM-III-R Psychiatric Disorders in the United States Results From the National Comorbidity Survey, *Arch Gen Psychiatry;51*(1):8–19, oi:10.1001/archpsyc.1994.03950010008002

Lalande, L., King, R., Bambling, M. & Schweltzer, R.D. (2017). An uncontrolled clinical trial of guided respiration mindfulness therapy (GRMT) in the treatment of depression and anxiety, *J Contempt Psychother, 47,* 251-258, doi: 10.1007/s10879-017-9360-0

Manocha, R., Black, D., Sarris, J. & Stough, C. (2011). A randomized, controlled trial of meditation for work stress, anxiety and depressed mood in full-time workers, *Evidence-Based Complementary and Alternative Medicine,* doi: 10.1155/2011/96058

Martin, A., Sanderson, K., Cocker, F. & Hons, B.A. (2009). Meta-analysis of the effects of health promotion intervention in the workplace on depression and anxiety disorders, *Scandinavian Journal of Work, Environment and Health,* 7-18

Newbury-Birch, D. & Kamali, F. (2001). Pyschological stress, anxiety, depression, job satisfaction, and personality characteristics in preregistration house officers, *Postgrad Med J, 77,* 109-111, retrieved from http://pmj.bml.com

Newby, J.M., Smith, J., Uppal, S., Mason, E., Mahoney, A.E.J. & Andrews, G. (2017). Internet-based cognitive behavioral therapy versus psychoeducation control for illness

anxiety disorder and somatic symptom disorder: A randomized controlled trial, *Journal of Consulting and Clinical Psychology, 86*(1), 89-98, doi: http://dx.doi.org/10.1037/ccp0000248

Newman, M. G., Przeworski, A., Consoli, A. J., & Taylor, C. B. (2014). A Randomized Controlled Trial of Ecological Momentary Intervention Plus Brief Group Therapy for Generalized Anxiety Disorder. *Psychotherapy (Chicago, Ill.), 51*(2), 198–206. http://doi.org/10.1037/a0032519

Nolen-Hoeksema, S., Wisco, B.E. & Lyubomirsky, S. (2008). Rethinking rumination, *Perspectives on Psychological Science, 3*(5), 400-424

Pascoe, M.C., Thompson, D.R. & Ski, C.F. (2017). Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis, *Psychoneuroendocrinology, 86,* 152-168, doi: http://dx.doi.org/10.1016/j.psyneuen.2017.08.008

Pieper, S. & Brosshot, J.F. (2005). Prolonged stress-related cardiovascular activation: Is there any? *The Society of Behavioral Medicine, 30* (2), 91-103, doi:

Omidi, A., Mohammadkhani, P., Mohammadi, A., & Zargar, F. (2013). Comparing Mindfulness Based Cognitive Therapy and Traditional Cognitive Behavior Therapy With Treatments as Usual on Reduction of Major Depressive Disorder Symptoms. *Iranian Red Crescent Medical Journal*, *15*(2), 142–146, doi: http://doi.org/10.5812/ircmj.8018

Rothmann, S. (2008). Job satisfaction, occupational stress, burnout and work engagement as components of work-related wellbeing. *SA Journal of Industrial Psychology*, *34*(3), 11-16. Retrieved July 19, 2018, from http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2071-07632008000300002&lng=en&tlng=es

Schell, K.L. & Grasha, A. F. (2000). State anxiety, performance accuracy, and work pace in a simulated pharmacy dispensing task, *Perceptual and Motor Skills, 90,* 547-561, doi:

Siegrist J. (2010). Effort-reward imbalance at work and cardiovascular diseases. *International Journal of Occupational Medicine and Environmental Health, 23,* 279-85.

Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I & Peter R. (2004). The measurement of effort–reward imbalance at work: European comparisons. *Social science & medicine, 58,* 1483-9, doi: 10.1016/S0277-9536(03)00351-4

Spijkerman, M.P.J., Pots, W. T.M. & Bohlmeijer, E.T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: A review and meta-analysis of randomized controlled trials, *Clinical Psychology Review, 45,* 102-114, doi: http://dx.doi.org/10.1016/j.cpr.2016.03.009

Spitzer RL, Kroenke K, Williams JBW, Löwe B. A Brief Measure for Assessing Generalized Anxiety DisorderThe GAD-7. *Arch Intern Med.* 2006;166(10):1092–1097. doi:10.1001/archinte.166.10.1092

Stein, M.B. & Sareen, J. (2015). Generalized anxiety disorder, *The New England Journal of Medicine, 373,* 2059-2068, doi: 10.1056/NEJMcp1502514

Steptoe, A., Siegrist, J., Kirschbaum, C. & Marmot, M. (2004). Effort-reward imbalance, overcommitment and measures of cortisol and blood pressure over the working day, *Psychosomatic Medicine, 66,* 323-329, doi: 0033-3174/04/6603-0323

Timulak, L., McElvaney, J., Keogh, D., Clare, P., Chepukova, E., Martin, E. & Greenberg, L.S. (2017). Emotion-focused therapy for generalized anxiety disorder: An exploratory study, *Psychotherapy, 54*(4), 361-366, doi: http://dx.doi.org/10.1037/pst0000128

Torous, J., Staples, P. & Onnela, J-P. (2015). Realising the potential of mobile mental health: New methods for new data in psychiatry, *Curr Psychiatry Rep, 17*(8), 602, doi: 10.1007/s11920-015-0602-0

Vlemincx, E., Vigo, D., Vansteenwegen, D., Bergh van den, O. & Diest van I. (2013). Do not worry, be mindfull: Effects of induced worry and mindfulness or respiratory variability in a nonanxious population, *International Journal of Psychophysiology, 87,* 147-151, doi: http://dx.doi.org/10.1016/j.ijpsycho.2012.12.002

Versluis, A., Verkuil, B., Spinhoven, P. & Brosschot, J.F. (2018) Feasibility and effectiveness of a worry-reduction training using the smartphone: a pilot randomised controlled trial, *British Journal of Guidance & Counselling*, doi: 10.1080/03069885.2017.1421310

Versluis, A., Verkuil, B., Spinhoven, P., Ploeg, van der M.M. & Brosschot, J.F. (2016). Changing mental health and positive psychological well-being using ecological momentary interventions: A systematic review and meta-analysis, *Journal of Medical Internet Research, 18*(6), doi: 10.2196/jmir.5642

Weaver, A. & Himle, J.A. (2017). Cognitive-behavioral therapy for depression and anxiety disorders in rural settings: A review of literature, *Journal of Rural Mental Health, 41*(3), 189-221, doi: http://dx.doi.org/10.1037/rmh0000075

Wuthrich, V.M., Johnco, C. & Knight, A. (2014). Comparison of the Penn State Worry Questionnaire (PSWQ) and abbreviated version (PSWQ-A) in a clinical and non-clinical population of older adults, *Journal of Anxiety Disorders, 28*(8), 657-663, doi: https://doi.org/10.1016/j.janxdis.2014.07.005

Williams, C.J., Dziurawiec, S. & Heritage, B. (2017). More pain than gain: Effort-reward imbalance, burnout, and withdrawal intentions within a university student population, *Journal of Educational Psychology,* doi: http://dx.doi.org/10.1037/edu0000212

Zalta, A.K. (2011). A meta-analysis of anxiety symptom prevention with cognitive-behavioral interventions, *Journal of Anxiety Disorders, 25,* 749-760, doi: 10.1016/j.janxdis.2011.02.007

Zelenski, J.M., Murphy, S.A. & Jenkis, D.A. (2008). The happy-productive worker thesis revisited, *Journal of Happiness Studies, 9*(4), 521-537, doi: https://doi.org/10.1007/s10902-008-9087-4

Zhong, J., Wang, C., Li, J., & Liu, J. (2009). Penn State Worry Questionnaire: structure and psychometric properties of the Chinese version. *Journal of Zhejiang University. Science. B, 10*(3), 211–218. http://doi.org/10.1631/jzus.B0820189

Zhu, B., Hedman, A., Feng, S., Li, H. & Osika, W. (2017). Designing, prototyping and evaluating digital mindfulness applications: A case study of mindful breathing for stress reduction, *Journal of Medical Internet Research, 19* (6), doi:10.2196/jmir.6955