



# Online mindfulness training for chronic pain

*- a randomized controlled trial*

Jessica Henriksson and Emma Vasara Möller

Tack!

Vi vill tacka vår handledare Michael Rönnlund för allt engagemang och all vägledning. Tack även till alla på Mindfulnesscenter som möjliggjorde detta examensarbete. Särskilt tack till Ola Schenström för det entusiasmerande stödet och till Susanne Sahlén Nyberg för den ovärderliga tekniska assistansen. Tack även till alla vid smärtrehabiliteringen på Norrlands universitetssjukhus för all hjälp under terminens gång och för assistans med rekrytering av deltagare. För detta vill vi även tacka alla inblandade från primärvården i Västerbottens läns landsting. Slutligen vill vi tacka alla övriga inblandade under resans gång och rikta ett extra stort tack till alla deltagare i projektet utan vilka detta examensarbete inte hade varit möjligt.

# ONLINE MINDFULNESS TRAINING FOR CHRONIC PAIN -A RANDOMIZED CONTROLLED TRIAL

Jessica Henriksson and Emma Vasara Möller

Mindfulness is a way of managing chronic pain and its consequences as it fosters an accepting approach to pain that can be beneficial in several aspects of life affected by pain. This study sought to examine whether an online mindfulness training program could reduce the experience of pain, increase acceptance of pain, and increase quality of life in a group of individuals suffering from chronic pain. The study was a randomized controlled trial with a partly active control group. Initially 52 participants were randomized to the intervention group and 55 to the control group. The drop out rates were high, 21 participants from the intervention group and 40 participants from the control group completed post measurement. Increased levels of mindfulness, reduced pain related distress, and heightened pain acceptance, as well as increased quality of life, was observed in the intervention group. A strong tendency towards a perceived reduction of pain intensity was also evident in the intervention group. As the mindfulness program had positive effects on the overall experience of pain it may serve as a cost-effective and useful method of dealing with chronic pain.

Mindfulness är ett sätt att hantera kronisk smärta och dess konsekvenser då det lär ut en accepterande inställning till smärta som kan vara till hjälp i flera aspekter av livet påverkade av smärta. Denna studie undersökte huruvida ett online-baserat mindfulnessprogram kunde minska upplevelsen av smärta, öka acceptans av smärta och öka livskvaliteten hos en grupp individer med kronisk smärta. Studien var randomiserad och kontrollerad med en delvis aktiv kontrollgrupp. Initialt randomiserades 52 deltagare till experimentgruppen och 55 deltagare till kontrollgruppen. Bortfallet var högt, 21 deltagare från experimentgruppen och 40 deltagare från kontrollgruppen fullgjorde eftermätningarna. Ökade nivåer av mindfulness, reducerat smärtrelaterat lidande, ökad acceptans av smärta såväl som ökad livskvalitet återfanns i experimentgruppen. En stark tendens till minskad upplevd smärtintensitet var också tydlig hos experimentgruppen. Då mindfulnessprogrammet hade positiva effekter på den övergripande upplevelsen av smärta kan det fungera som en kostnadseffektiv och användbar metod att hantera kronisk smärta.

Keywords: Mindfulness, chronic pain, persistent pain, Internet-based treatment, Breathworks, acceptance-based treatment

Conditions involving chronic pain cause individual suffering as well as substantial social costs (SBU, 2006). The International Association for the Study of Pain (International Association for the Study of Pain, 2013) defines pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”. This is the most widespread definition of pain. The experience of pain is affected by factors such as the individual’s emotions, context, historical and cultural background, as well as the individuals appraisals of the symptoms (Turk & Okifuji, 2002).

Chronic pain is often defined as pain that has persisted longer than three or six months (e. g. Breivik, Collett, Ventafridda, Cohen & Gallacher, 2006; Gerdle, Björk, Henriksson & Bengtsson, 2004) and may be distinguished from acute pain which

has a shorter duration. Chronic pain, however, is not the same as prolonged acute pain. Instead, it could be described as an experience of a disabling disease (Chapman & Gavrin, 1999). The diagnosis is non-uniform with differences in distribution, states, severity and functional impact (Bergman et al., 2002). Once the pain has been established as chronic, the chances of becoming pain free are relatively small (e.g. Andersson, 2004; Bergman, Herrström, Jacobsson & Petersson, 2002). Chronic pain is a relatively common condition. The prevalence of moderate to severe chronic pain in a Swedish sample has been estimated to 18% (Breivik et al., 2006). Other studies have shown prevalence rates for chronic pain in general at about 50% (Gerdle, Björk, Henriksson & Bengtsson, 2004; Jakobsson, 2010).

In regard to effects of chronic pain on other subject variables, it has been shown that individuals suffering from chronic pain are less satisfied with their lives compared to controls. The largest differences in life satisfaction were found in the domains of physical and psychological health (Silvemark, Källmén, Portala & Molander, 2008). This is in accordance with results from other studies associating chronic pain with decreased quality of life (e.g. Breivik et al., 2006; Lamé, Peters, Vlaeyen, Kleef & Patijn, 2005).

Chronic pain has, in addition, been shown to affect aspects of life such as sleep, BMI, fatigue, and mobility negatively (Jakobsson, 2010). As these symptoms often accompany the pain it could result in feelings of sickness, exhaustion and impairment. This state of suffering resembles depression but is different from depression as it is a wider concept, not necessarily psychopathological. In cases of chronic pain, the individual is more focused on suffering in the future than on negative affect towards the self (Chapman & Gavrin, 1999).

Chronic pain is hard to treat effectively. The most common treatment for chronic pain is a variety of pain reduction treatments such as analgesic and opioid drugs. This kind of treatment only reduces pain by 30-40% in about half of the patients. Surgery for chronic pain conditions, especially chronic back pain, is common but does not remove the pain to a satisfactory level (Turk, 2002). Multimodal rehabilitation is used for chronic pain for patients with extensive and complex needs. This type of rehabilitation includes contribution from different lines such as psychology, physiotherapy, medicine et cetera. Multimodal rehabilitation provides better long term results on aspects of life such as return to work than less extensive interventions do (SBU, 2006).

Cognitive Behavioral Therapy (CBT) has shown to mainly be associated with improvements in quality of life. CBT also appear to have some effect on pain and psychological distress. In particular, coping skills training with a focus on cognitive skill development and practice seems to be effective (Eccleston, Morley & Williams, 2013).

Given that the foregoing methods for reducing pain have some drawbacks (e.g. with regard to costs, time consumption et cetera, an increased interest in alternative means to reduce pain has been seen in recent years. Recent research

has also focused on mindfulness-based interventions (MBIs) for chronic pain (Reiner, Tibi & Lipsitz, 2013), that also served as a basis for the present study.

Mindfulness has been described as “paying attention in a particular way; on purpose, in the present moment, and nonjudgmentally” (Kabat-Zinn, 1994, p. 4). Bishop et al. (2004) proposed an operational definition of mindfulness consisting of two components: self-regulation of attention and orientation to experience. Self-regulation of attention involves skills in sustained attention and attention switching as well as inhibition of elaborative processing. Orientation to experience involves curiosity, openness and acceptance towards the current experience. These attitudes provide a non-elaborative awareness to the experience as well as a decentered and more insightful perspective on thoughts and feelings. By this definition, mindfulness is a metacognitive process as it requires both control of cognitive processes and the ability to monitor the stream of consciousness (Bishop et al., 2004).

Brown and Ryan (2003) found positive relationships between mindfulness and several health benefits such as life satisfaction and optimism. Being mindful has also been found to exhibit a negative relationship with depression, anxiety and self-consciousness (Brown & Ryan, 2003). Thus, mindfulness seems to positively influence psychological well-being. It has become a popular element in psychological treatments (Baer, 2009) and is considered a powerful and widely applicable intervention in counseling (Brown, Marquis & Guiffrida, 2013).

MBIs have been used in treatment of patients with chronic pain. Unfortunately, there is no consensus regarding the effects MBIs have on pain intensity. More specifically, two reviews (Chiesa & Serretti, 2011; Veehof, Oskam, Schreurs & Bohlmeijer, 2011) show inconclusive results regarding MBIs on pain intensity while a third review (Reiner et al., 2013) concluded that MBIs have an effect on pain intensity. Partially due to the lack of high quality randomized and controlled studies it is therefore difficult to conclude anything absolute regarding the effectiveness of MBIs to reduce perceived pain intensity based on those studies.

Despite the uncertainty of MBIs possible effects on pain intensity there is more of consensus regarding the effects on psychological and secondary outcome measures. MBIs increase pain acceptance and tolerance (Chiesa & Serretti, 2011) and also appear to have positive effects on psychological features related to pain such as decreased levels of depressive symptoms and increased levels of life quality (Chiesa & Serretti, 2011; Veehof et al., 2011). Although Chiesa and Serretti (2011) did not find that MBIs necessarily were more efficient in treating pain than education or other types of controls, they still proposed a way of which the effects of mindfulness on pain can be understood. In accordance to the operational definition of mindfulness, Chiesa and Serretti hypothesized that MBIs alters how psychological processes and contents are experienced rather than altering the pain itself. Veehof et al. (2011) also questioned whether pain intensity is a valid outcome measure for patients with chronic pain since MBIs do not intend to change the pain itself but rather promote acceptance of pain. Reiner et al. (2013) who concluded that MBIs can reduce pain intensity also hypothesized that the

reduction in pain intensity could be an effect of reduced pain avoidance and increased engagement in valuable activities.

Whether the effect is on the pain itself or via secondary measures such as increased quality of life or reduced pain avoidance, mindfulness seems to have a positive effect on the experience of pain. A study examining more acute pain found decreases in pain and anxiety ratings when exposed to experimentally induced pain after only three days of mindfulness training (Zeidan, Gordon, Merchant & Goolkasian, 2010). Liu, Wang, Chang, Chen, and Si (2013) also found significant positive effects of brief mindfulness training on pain tolerance and distress when exposed to experimentally induced pain. Immediate effects of a single mindfulness exercise on chronic pain have also been observed in a clinic setting (Ussher et al., 2012).

Studies on brief online mindfulness training programs indicate that mindfulness programs can be successfully administered online (Cavanagh et al. 2013; Glück & Maercker, 2011). Online mindfulness training programs are easily accessible and could be a powerful complement to pain treatment and rehabilitation programs as it is a cost-effective means of adding to, or administering a mindfulness component in the treatment.

To our knowledge, there are no previous studies on online mindfulness training programs for chronic pain. A study on mindfulness for chronic pain taught via videoconference showed positive results in parity to face-to-face training (Gardner-Nix, Backman, Barbati & Grummitt, 2008) but was more interactive than the program used in the present study as it included personal contact with an instructor. Two recent studies (Krusche, Cyhlarova & Williams, 2013; Morledge et al., 2013) have investigated the feasibility and effects of longer mindfulness programs without personal contact and found promising effects but none of them investigated programs directed towards pain.

The present study served as a pilot-study on an online mindfulness program for chronic pain. The overall purpose was to examine whether an online mindfulness training program reduced the experience of pain in individuals suffering from chronic pain. More specifically, we set out to investigate whether this web-based mindfulness program has an effect on experience of pain, quality of life and acceptance of pain. To this end a randomized controlled design with an active control group with access to an online discussion forum was adopted, a design that, as noted, seldom has been used in past research on MBIs, despite its advantages in regard to control of potential confounding factors.

## Method

### *Participants*

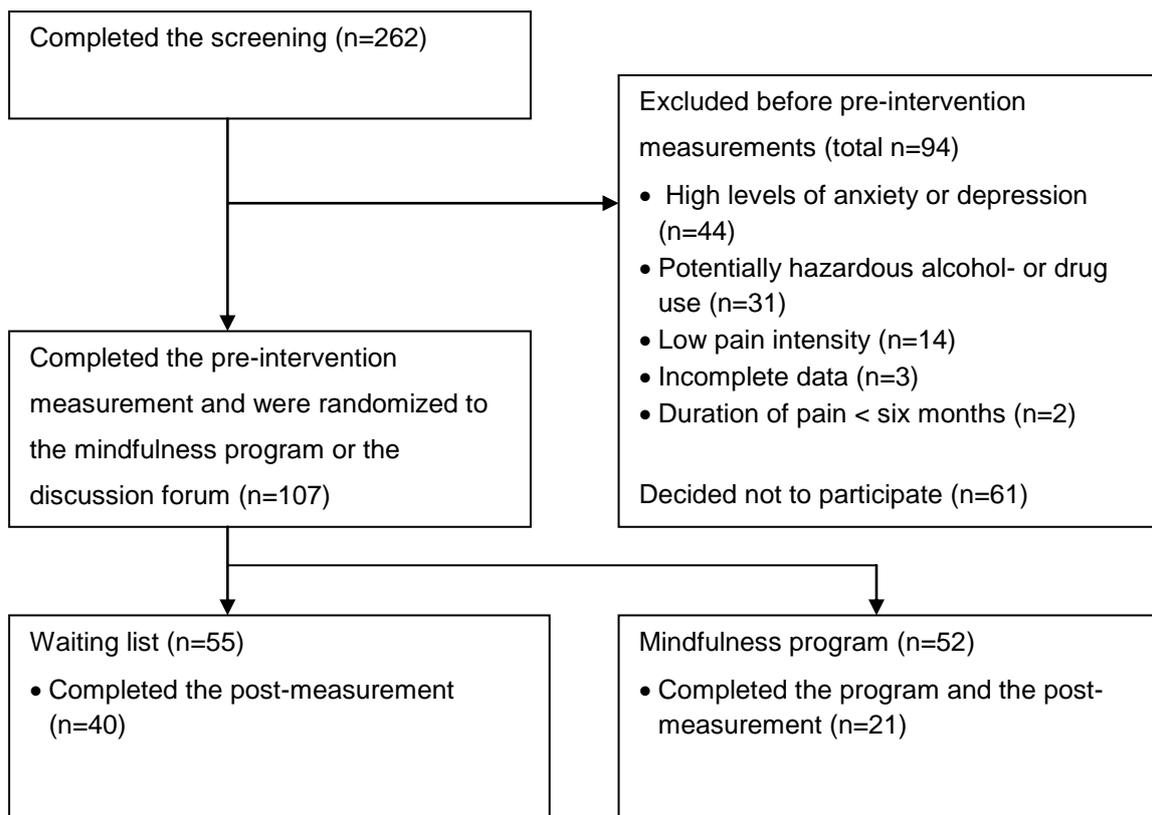
The participants were recruited online as well as in primary care settings and a pain clinic. 262 agreed to a consent form and filled out the first round of questions.

### *Inclusion and exclusion criteria*

To be included in the present study participants had to be over 18 years old and suffer from pain at an intensity of four out of ten that had persisted for at least six months. Participants were excluded if they scored over six or eight on AUDIT or if their DUDIT score indicated any illicit drug use. As shown in Figure 1, participants were also excluded on the basis of their HADS results. Cut-off scores of 10 for the depression subscale and 16 for the anxiety subscale were used.

As shown in Figure 1 the present study finally included 107 participants. 93% (n=100) were female and the average age was 51 years. 48% (n=51) were on a sick-leave due to their pain, and the mean length of absence from work was 8 years.

The largest part (36%, n=39) of the participants reported that the main location of pain varies. Other responses were divided fairly equally amongst specific body parts. 46% of the participants reported at least some previous experience of mindfulness.



*Figure 1.* Flow chart of participants: exclusion and decided not to participate.

## *Material*

### *Alcohol Use Disorders Identification Test (AUDIT)*

AUDIT is a ten-question questionnaire used as a screening measure for hazardous alcohol use (Fiellin, Reid & O'Connor, 2000) and alcohol dependence (Hulse, Saunders, Roydhouse, Stockwell, and Basso, 2000). The Swedish version of AUDIT has been shown to have good specificity and sensitivity for measuring high-volume drinking and dependence when using a cutoff score at 8 (Selin, 2006). The best specificity and sensitivity regarding heavy-drinking among middle-aged women are reached when using a cutoff score at 6 (Aalto, Tuunanen, Sillanaukee & Seppa, 2006). Hence, the cut-off scores used in the present study were 8 for men and 6 for women. AUDIT has shown moderate concurrent validity to the alcohol problem severity domain of the Addiction Severity Index (ASI-6) and an internal consistency (Cronbach's alpha) at .89 (Durbeej, Berman, Gumpert, Palmstierna, Kristiansson & Alm, 2010).

### *Drug Use Disorders Identification Test (DUDIT)*

DUDIT measures drug use and consequences of that use over the past year (Voluse, Gioia, Sobell, Dum, Sobell, & Simco, 2012). The Swedish version of DUDIT has been found to have an internal consistency (Cronbach's alpha) at .94. The instrument has furthermore been demonstrated to have good concurrent validity as reflected by a substantial relationship the drug problem severity domain of the ASI-6 (Durbeej et al., 2010).

For the purpose of this study the DUDIT was primarily used as a measure for current drug use. Participants who exhibited current drug use were excluded from the study. The participants were allowed to score above 0 on two questions which measured drug-related social consequences during the last year, if they scored 0 on the other items regarding current drug use.

### *Hospital Anxiety and Depression Scale (HADS)*

Both of the anxiety and the depression subscale in the Swedish version of the HADS have exhibited adequate internal consistency, with Cronbach's alpha = .84 for HAD-A,  $\alpha = .82$  for HAD-D (Lisspers, Nygren, & Söderman, 1997).

The cut-off scores for this study were different for the depression subscale and the anxiety subscale. For the depression subscale a cutoff score at 10 was used to capture participants with even mild cases off depression. For the anxiety subscale a cutoff score at 16 was used to only include those with severe anxiety. The cutoff score for these purposes is recommended by the developers (Snaith & Zigmond, 1994 in Crawford, Crombie & Taylor, 2001). When administered on the Internet the HADS has shown to provide meaningful and valid data (Andersson, Kaldö-Sandström, Ström & Ström, 2003).

### *Chronic Pain Acceptance questionnaire (CPAQ)*

CPAQ is an instrument measuring acceptance in relation to perceived pain. It has been used in several studies on mindfulness and pain (e.g. McCracken & Zhao-O'Brien, 2010; Cusens, Duggan, Thorne & Burch, 2010). Its 20 items are divided in to two subscales: activities engagement and pain willingness (Vowles, McCracken,

McLeod & Eccleston, 2008). Higher scores indicate higher levels of pain related acceptance, with possible scores ranging from 0 to 120. The possible score on the subscale activities engagement ranges from 0 to 66 and the score on the subscale pain willingness ranges from 0 to 54.

CPAQ is regarded as a valid instrument for measuring pain related acceptance (McCracken, 2004), even when administered online (Fish, McGuire, Hogan, Morrison, & Stewart, 2010). The Swedish version of the instrument has shown good psychometric properties with regard to internal consistency with a Cronbach's alpha reaching .91 (Wicksell, Olsson & Melin, 2009).

#### *Brief screening version of the Multiple Pain Inventory*

The brief screening version of the multiple pain inventory is a screening instrument for chronic pain which consists of eight questions from the first section of the Swedish version of the multiple pain inventory (MPI-S) (Jakobsson, 2009). The original version of the MPI was designed to measure pain from a multidimensional perspective, considering not only pain severity but also other factors such as affective distress and support from others (Turk, 2005). Even though the brief screening version of the MPI-S does not include as many aspects of pain as the full version, it still provides more information regarding the experience of pain than unidimensional measures and can be considered a better option when measuring pain. The brief screening version is comprised of four subscales: pain severity, interference, life control and affective distress. In this study the scoring method used calculates the mean score of each subscale as suggested by Jakobsson, 2009. Scores can range from 0 to 6, where higher score indicate higher impact of the aspects that the subscale is supposed to measure.

With Cronbach's alpha ranging from .68 to .93 for the different scales, the Swedish brief screening version of the instrument has been found to show acceptable reliability and validity in all age groups, except for the oldest old. A standard scoring method for the instrument does not exist and it can only detect cases with severe dysfunction (Jakobsson, 2009).

#### *Numerical Rating Scale (NRS)*

Two numerical rating scales are used in the present study. One where participants are asked to rate their average amount of pain during the past week and another in which participants are asked to rate the amount of suffering their pain had caused them during the past week. The scales range from 0 to 10, where 0 indicates "no pain/distress" and 10 "pain/distress as bad as it could be".

#### *Five Facet Mindfulness Questionnaire (FFMQ)*

The FFMQ provides a multifaceted way of measuring the tendency to be mindful in daily life (Christopher, Neuser, Michael & Baitmangalkar, 2012). Measuring mindfulness as a multifaceted construct is recommended by Baer, Smith, Hopkins, Krietemeyer and Toney (2006) since it can provide insight in to the components of mindfulness and its relationships with other variables. The five subscales are: observing, describing, acting with awareness, nonreactivity and nonjudging (Baer et al., 2006). Possible scores on the full scale on FFMQ ranges from 29 to 145,

where higher scores indicate higher mindfulness levels. All of the subscales have been found to show acceptable validity and reliability (Christopher et al., 2012) and this applies to the Swedish version of the instrument as well with Cronbach's alpha of .81 (Lilja et al., 2011).

#### *Life Satisfaction (LiSat-11)*

Life satisfaction was measured by the life satisfaction checklist (LiSat-11). LiSat-11 is an 11 item questionnaire measuring global- as well as domain-specific life satisfaction. The score is received by calculating the mean value of the answers, with possible scores ranging from 1 to 6. Higher scores indicate higher life satisfaction. It has been found to show acceptable construct validity as well as internal reliability with a Cronbach's alpha at .82 (Silvemmark, Källmén, Portala & Molander, 2008).

#### *The mindfulness program*

The mindfulness program "Mindfulness - living with pain" is a program that intends to help people with chronic pain to find new ways of dealing with the pain and has a strong emphasis on acceptance of pain. The program was originally developed by Vidyamala Burch and Breathworks and was then adapted to an online Swedish version by Mindfulnesscenter AB (Breathworks, 2013). The program in its original form has been evaluated showing positive changes on several pain-related health problems such as pain catastrophizing and pain acceptance even though pain intensity ratings remained the same even after completing the program (Cusens, Duggan, Thorne & Burch, 2010). The main components in the program are mindfulness exercises, which the participants are to perform twice daily. The duration of each exercise is about ten minutes and the exercises follow eight steps, one for each week of the program.

The steps were labeled: 1) The breathing body, 2) Dwelling in the body, 3) Mindfulness of moving and living, 4) Acceptance and self-compassion, 5) The treasure of pleasure, 6) Being whole, 7) Turning outwards - compassion for others, and 8) The journey continues - living with choice. Each step includes a few exercises specific to that step even though some exercises are repeated in several steps (Breathworks, 2013).

#### *The discussion forum*

The participants in the control group were provided an anonymous and monitored online discussion forum. Each week a new discussion topic was introduced by the authors and the discussions were then held amongst the participants without any input from the authors. The discussion topics were not related to mindfulness and did not have a therapeutic character. The topics included were for example: "How is chronic pain presented in the media?", "Is it helpful to meet other individuals with chronic pain?" and "What experience do you have of the health care system?". Before entering the discussion forum the participants were asked to read information regarding anonymity in the forum. They were also informed of a previous study of Lorig et al. (2002) who found positive effects on pain, disability, role function, and health distress in subjects with chronic back pain after participation in an internet-based discussion. 42 participants created a user for the

discussion forum which enabled them to participate as well as take part in the discussions. 27 users posted comments while the remaining 15 participants did not post comments but could have been active as readers. There was no way of controlling for their activity in the forum. Therefore the discussion forum was defined as a partly active control condition.

### *Design*

The design of the present study was a between groups, randomized controlled trial.

### *Procedure*

Participants were informed of the study and were asked to fill out a consent form via a web page. They completed a screening procedure involving administration of Hospital Anxiety and Depression Scale (HADS), Alcohol Use Disorders Identification Test (AUDIT), Drug Use Disorders Identification Test (DUDIT), together with questions concerning demographics and questions concerned with pain. Participants who met the inclusion criteria were sent pre-intervention questionnaires a week before the program started. The questionnaires that the participants were to answer were Chronic Pain Acceptance Questionnaire (CPAQ), brief screening version of the Multiple Pain Inventory (MPI), Five Facet Mindfulness Questionnaire (FFMQ) and Life Satisfaction Questionnaire -11 (LiSat-11). These questionnaires were complemented by an Numeric Rating Scale (NRS) regarding the distress caused by their current pain and questions about their experience of mindfulness. They were also asked to fill out an NRS regarding the current severity of their pain the day before the program started.

After submitting the final NRS the participants were randomly assigned to a control- and a intervention group. The randomization was conducted using an online randomizer ([www.randomizer.org](http://www.randomizer.org)). Next, the participants received information on whether they were to begin by participating in the discussion forum or the mindfulness program. On the fourth week of the program, encouraging e-mails were sent to the participants in the experimental group.

Program completion was defined as having completed at least six weeks of the mindfulness program. 21 individuals completed the program. Of the remaining participants, 13 were on the first step of the program while the other 15 participants were divided amongst the five steps in between the first and the final two.

Once the mindfulness program was completed, participants in both groups received post-intervention questionnaires. The participants in the control group were given access to the mindfulness program when they completed the post-intervention questionnaires.

### *Ethical considerations*

The intervention was defined as a pedagogic program which is equated with reading a self-help book. Hence, the mindfulness program was not considered as treatment, thus eliminating the need for record keeping in accordance to Swedish

regulations. To identify the participants their e-mail addresses were used. As e-mail addresses are unique but not necessarily coupled with personal data or information they were used as identifying information throughout the study. The participants were asked to fill in a consent form with information about the study before the study began. By agreeing to the consent form the participants validated that they had read and agreed to the information and conditions of the study. The consent form included information regarding confidentiality of the results and made it clear that all participation was voluntary.

## Results

The first analyses addressed potential effects associated with attrition, or drop-out. Next, analyses of variance (ANOVAs) were conducted to compare the mean-levels (pre- vs. post-intervention) on the following variables: mindfulness level, pain intensity and pain experience, acceptance of pain, distress caused by pain and life satisfaction. Effect sizes for all the significant results were calculated using partial eta square ( $\eta_p^2$ ). Within group effect sizes for the intervention group were calculated using Cohen's *d*. Cohen (1992) defined a small effect size as  $d > 0.2$ , a medium effect size as  $d > 0.5$  and a large as  $d > 0.8$ .

### *Drop-out analysis*

Analyses of the drop-out was conducted by *t*-tests (for independent groups) on the following variables: age, level of mindfulness, pain intensity, sick-leave due to pain, potential pain diagnosis, potential medication for pain, duration of pain and quality of life. No significant differences between the participants who dropped out and the returnees were observed. Thus, the two groups may be regarded as comparable at time of entry in the study.

To analyze the data 2 x 2 mixed ANOVAs were conducted. More specifically, the group factor (intervention vs. control) was a between-subjects factor and time varied within subjects (repeated measures).

### *Mindfulness levels*

To compare mindfulness levels between the intervention group and control group the total score on FFMQ was used as dependent variable. Figure 2 shows means of the FFMQ in the two groups and as we can see the means reveal little change for the control group but a substantial mean increment for the intervention group. The ANOVA results substantiated this impression by showing a significant main effect of time  $F(1, 59) = 7.90$ ,  $MSE = 198.44$ ,  $p < .05$ ,  $\eta_p^2 = .12$  reflecting the fact that the total score on FFMQ was higher on the second time of measurement. The main effect of group was on the other hand not significant  $F(1, 59) = 3.49$ ,  $MSE = 187.22$ ,  $p > .05$ . Most critical, the interaction effect was highly significant  $F(1, 59) = 12.05$ ,  $p < .001$ ,  $\eta_p^2 = .17$ . The intervention group exhibited higher levels of mindfulness than the control group after having completed the mindfulness program. The intervention group exhibited significantly higher end results than the control

group which did not significantly differ between the two times of measurement. The effect size within the intervention group was large and calculated to  $d = 1.53$ .

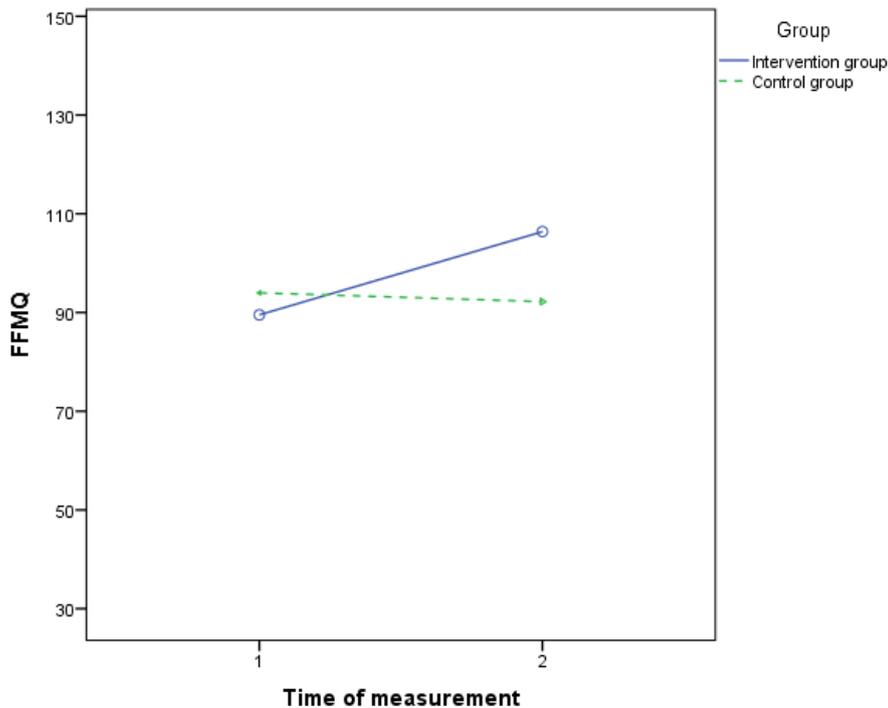


Figure 2. Pre and post measurement means on the FFMQ for the intervention and control group.

FFMQ was next analyzed at the subscale level. The results of the ANOVAs on these subscales were similar to the result of the total score on FFMQ, suggesting that no specific subscale is responsible for the result on the ANOVA of the total score.

#### *Pain measurements*

For comparison on pain intensity ratings, the scores on NRS were used as a dependent variable. The main effect of time was significant  $F(1, 59) = 10.80$ ,  $MSE = 1.76$ ,  $p < .05$ ,  $\eta_p^2 = .13$ , reflecting a lower score on pain in the second time of measurement. As for the main effect of group the result showed no difference in scored pain intensity between the groups  $F(1, 59) = 2.08$ ,  $MSE = 5.40$ ,  $p > .05$ . The interaction effect of time and group on the NRS score exhibited no significant difference  $F(1, 59) = 3.25$ ,  $p > .05$ . Even though changes in pain intensity measured with an NRS did not reach significance a tendency towards less pain for the intervention group was evident.

As an alternative measure of the experience of pain, the subscales of MPI-S brief screening version were used. Pain intensity was measured by using the pain severity subscale as the dependent variable. Means are presented in Figure 3. The ANOVA revealed significant main effects on time  $F(1, 59) = 7.53$ ,  $MSE = 0.26$ ,  $p < .01$ ,  $\eta_p^2 = .11$ , indicating that the scores were lower at the second time of

measurement. No significant main effect of group was observed  $F(1, 59) = 2.98$ ,  $MSE = 0.80$ ,  $p > .05$ . The results of the interaction effect of group and time were significant  $F(1, 59) = 5.57$ ,  $p < .05$ ,  $\eta_p^2 = .09$  which implies that the mindfulness program has an effect on pain intensity when measured with MPI-S brief screening version. The effect size within the intervention group was measured to a medium level ( $d = 0.59$ ).

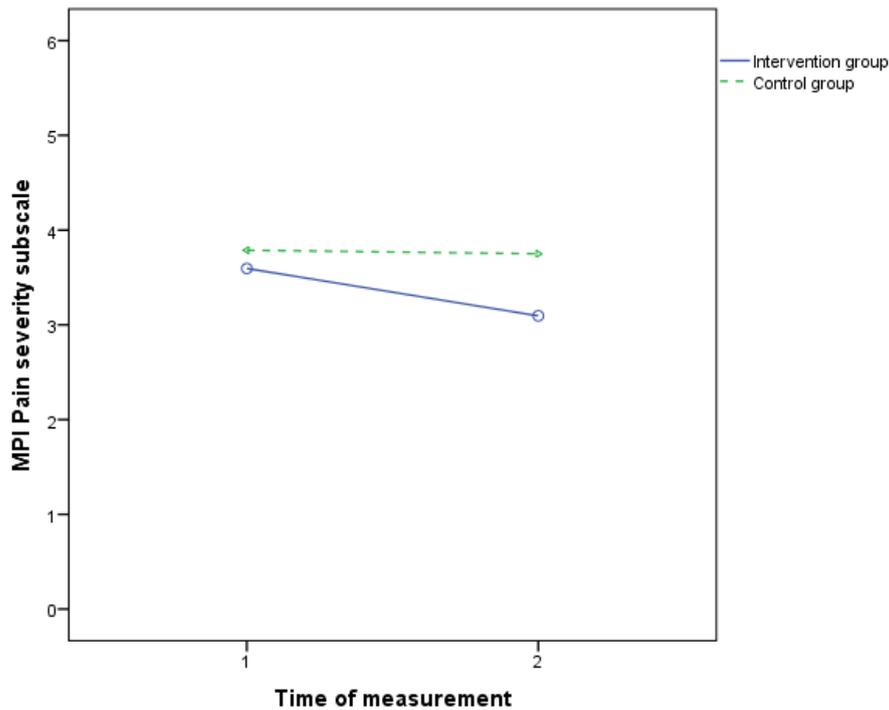


Figure 3. Pre and post measurement means for the intervention and control group on the pain severity subscale of the MPI.

To compare the groups on the second subscale in the brief screening version of the MPI-S the interference subscale was used as dependent variable. Means are shown in Figure 4. A significant main effect of time was observed  $F(1, 59) = 18.86$ ,  $MSE = 0.80$ ,  $p < .001$ ,  $\eta_p^2 = .24$ , as the scores were lower on the second time of measurement compared to the first. There was no main effect of group  $F(1, 59) = 2.46$ ,  $MSE = 3.99$ ,  $p > .05$  but when time and group interacts it reveals a significant interaction effect  $F(1, 59) = 8.67$ ,  $p < .01$ ,  $\eta_p^2 = .13$ . The intervention group scored significantly lower on interference on the second time of measurement while there was no significant difference between the two times of measurements in the control group. The effect size within the intervention group was large ( $d = 0.74$ ).

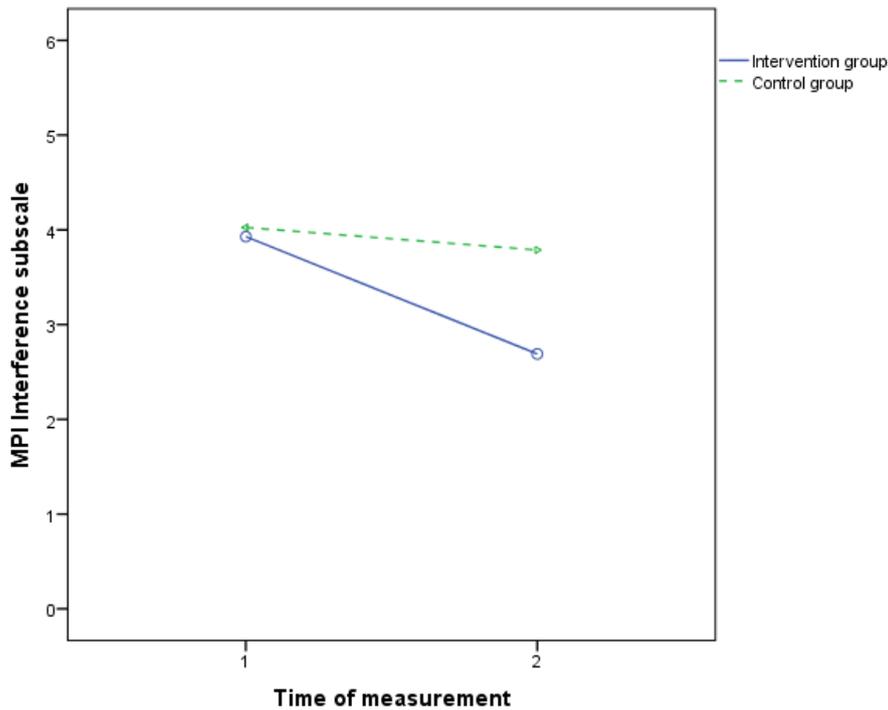


Figure 4. Pre and post measurement means for the intervention and control group on the interference subscale of the MPI.

The perceived life control in relation to pain was measured with the third subscale of the brief screening version of the MPI-S. The subscale was used as the dependent variable in this ANOVA, where a main effect of time was observed  $F(1, 59) = 9.61, MSE = 0.98, p < .01, \eta_p^2 = .14$ . At the second time of measurement the perceived life control was higher. There was no main effect of group  $F(1, 59) = 3.28, MSE = 2.48, p > .05$ . No significant interaction effect appeared  $F(1, 59) = 2.48, p > .05$  meaning that the difference between the scores at the second time of measurement in the intervention group and control group was not significant in relation to the scores at the first time of measurement.

To compare experiences of affective distress in regard to pain the fourth and last subscale in MPI-S brief screening version was used as dependent variable. In Figure 5 the means can be viewed. A significant main effect of time  $F(1, 59) = 8.26, MSE = 0.93, p < .01, \eta_p^2 = .12$  was revealed, the scores were lower at the second time of measurement. No significant main effect of group was observed  $F(1, 59) = 3.63, MSE = 2.46, p > .05$ . The interaction effect, on the other hand, was significant  $F(1, 59) = 9.48, p < .01, \eta_p^2 = .14$ . The intervention group decreased significantly in measured affect distress from the first to the second time of measurement but no such difference could be observed in the control group. The effect size for the intervention group was calculated to  $d = 0.82$ , a large effect size.

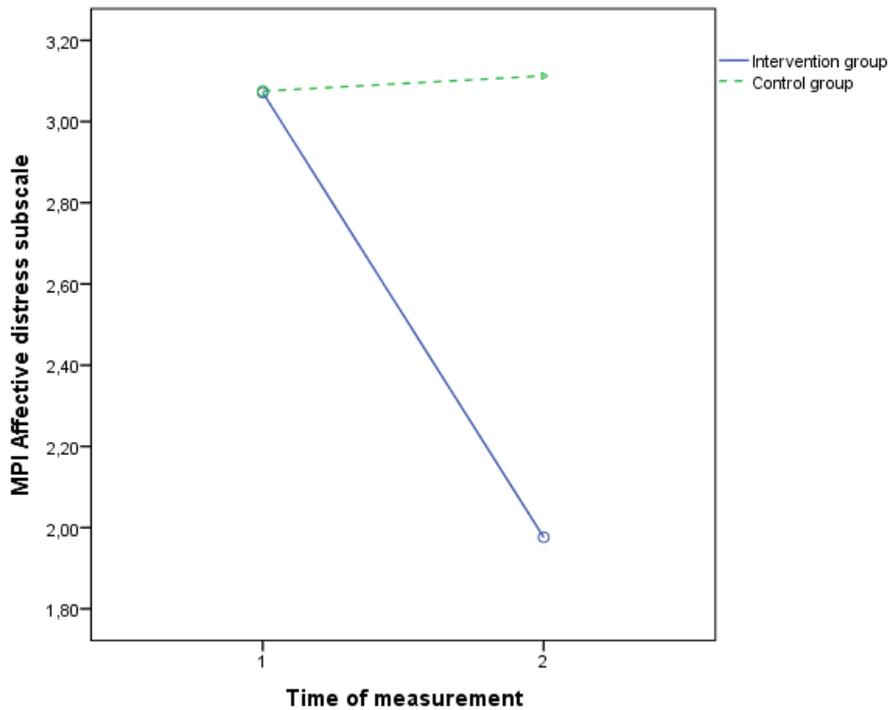


Figure 5. Pre and post measurement means for the intervention and control group on the affective distress subscale of the MPI.

#### Acceptance of pain

CPAQ measures acceptance of pain and can be divided into two subscales: pain willingness and activities engagement. For comparison of pain willingness, this subscale was used as a dependent variable. A significant main effect on time was revealed,  $F(1, 59) = 21.43$ ,  $MSE = 14.46$ ,  $p < .001$ ,  $\eta_p^2 = .27$ . indicating that the participants rated their pain willingness higher at the second time of measurement. There was no significant main effect of group  $F(1, 59) = 0.53$ ,  $MSE = 14.46$ ,  $p > .05$ . The interaction effect was not significant either  $F(1, 59) = 1.83$ ,  $p > .05$ .

Comparisons of activities engagement, used this subscale as the dependent variable. Means are presented in Figure 6. A significant main effect of time was observed  $F(1, 59) = 17.01$ ,  $MSE = 20.14$ ,  $p < .001$ ,  $\eta_p^2 = .22$ , but not of group  $F(1, 59) = 1.20$ ,  $MSE = 157.31$ ,  $p > .05$ , indicating that that the mean score was higher at the second time of measurement. The interaction effect was significant  $F(1, 59) = 7.73$ ,  $p < .01$ ,  $\eta_p^2 = .03$ . This means that the intervention group exhibited higher levels of activities engagement after the intervention when compared to the control group. The effect size within the intervention group was at a medium level ( $d = 0.62$ ).

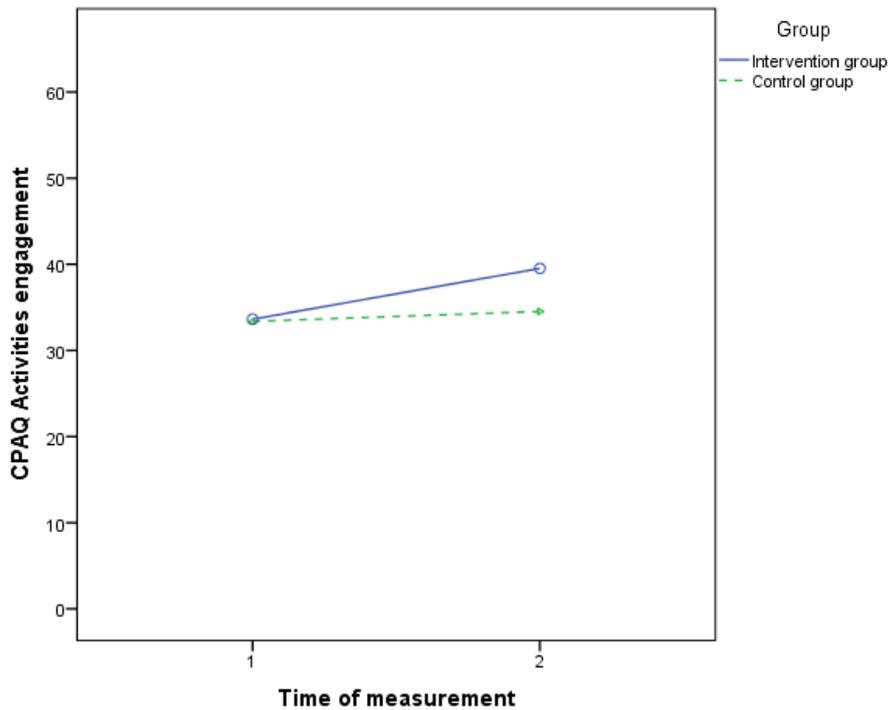


Figure 6. Pre and post measurement means for the intervention and control group on the activities engagement subscale of the CPAQ.

For comparisons on total score of CPAQ, this was set as a dependent variable. Means are presented in Figure 7. The ANOVA revealed a significant main effect of time  $F(1, 59) = 29.26, MSE = 44.57, p < .001, \eta_p^2 = .33$  meaning that the acceptance levels were higher on the second time of measurement. No main effect of group was observed  $F(1, 59) = 1.12, MSE = 359.13, p > .05$ . When the variables time and group interact a significant interaction effect is revealed  $F(1, 59) = 6.95, p < .05, \eta_p^2 = .11$ , this suggests that the intervention group had increased their score from the first measurement to the second measurement when compared to the control group. The effect size for the intervention group was at a medium level ( $d = 0.71$ ).

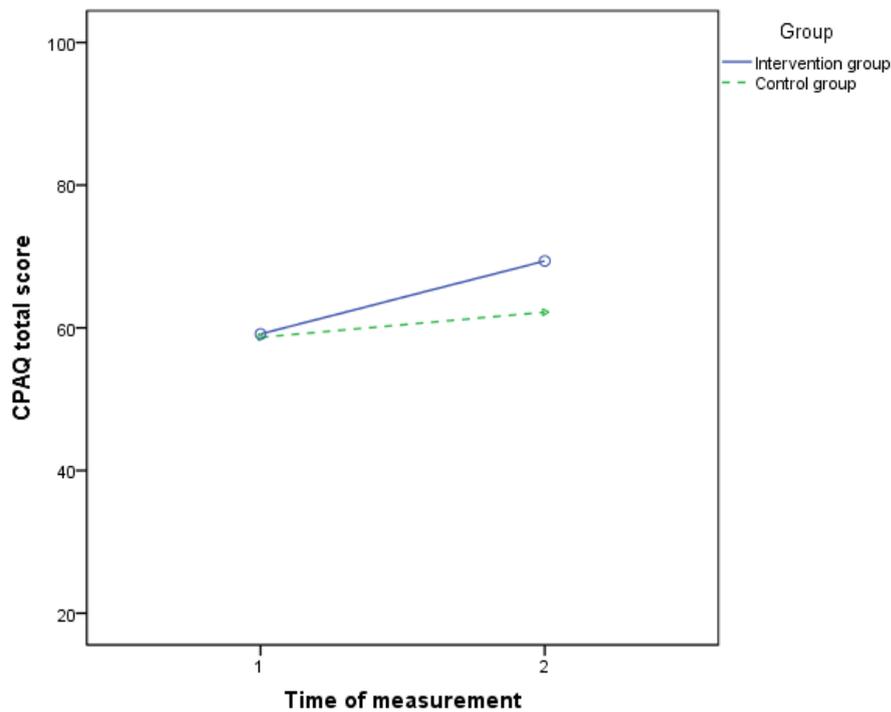


Figure 7. Pre and post measurement means for the intervention and control group on the total CPAQ scores.

*Distress caused by pain*

To evaluate whether the mindfulness program decreased the distress that follows the pain an ANOVA with an NRS for distress as dependent variable was created. The means are exhibited in Figure 8. The result showed significant main effects of both time  $F(1, 59) = 22.29, MSE = 2.31, p < .001, \eta_p^2 = .27$  and group  $F(1, 59) = 5.83, MSE = 6.22, p < .05, \eta_p^2 = .09$ . The rated distress was lower at the second time of measurement and in the intervention group compared to the control group. The interaction effect of time and group was significant  $F(1, 59) = 11.15, p < .001, \eta_p^2 = .16$ . After completing the mindfulness program the intervention group exhibited significantly lowered scores of suffering while there was no significant difference among the control group between the two times of measurement. The effect size within the intervention group was  $d = 1.32$ , which is considered a large effect size.

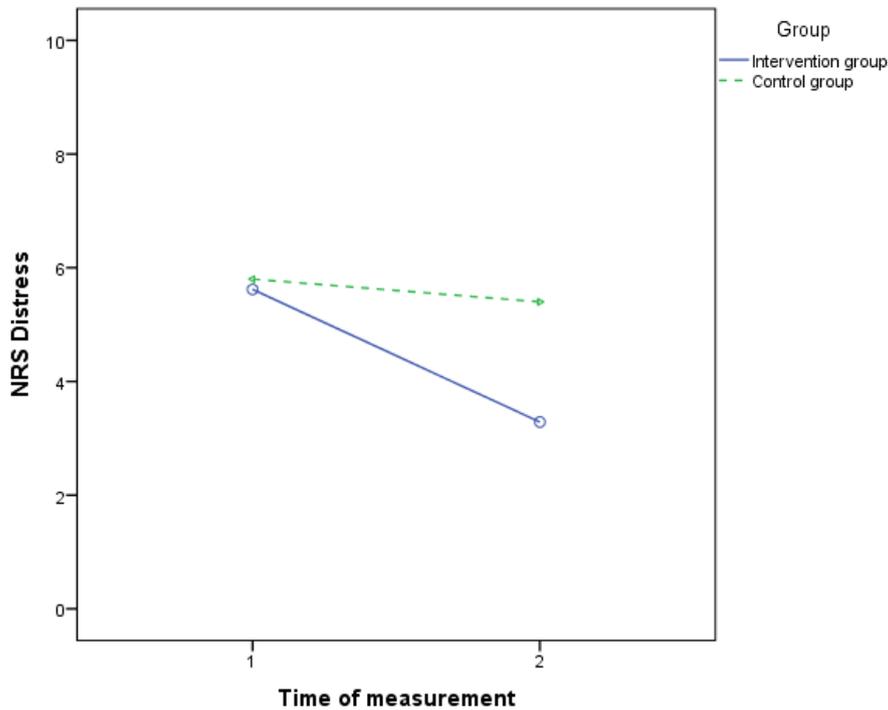


Figure 8. Pre and post measurement means for the intervention and control group on the NRS measuring distress caused by pain.

#### Life Satisfaction

For comparison on life satisfaction LiSat-11 was used as a dependent variable. The mean scores differences are shown in Figure 9 and indicate equivalent ratings at the first measurement between the two groups but appear to be much higher in the intervention group at the second time of measurement. This observation was confirmed by using an ANOVA which revealed a main effect of time  $F(1, 59) = 12.01, MSE = 0.13, p < .001, \eta_p^2 = .17$  the scores were higher at the second time of measurement. No main effect of group was observed  $F(1, 59) = 0.71, MSE = 0.93, p > .05$ . The interaction effect of time and group was significant  $F(1, 59) = 4.53, p < .05, \eta_p^2 = .07$  which means that the increase in the ratings on LiSat-11 in the intervention group between the first and second time of measurement was significant and significantly larger than the change in ratings in the control group. The effect size for the intervention group was at a medium level at  $d = 0.55$ .

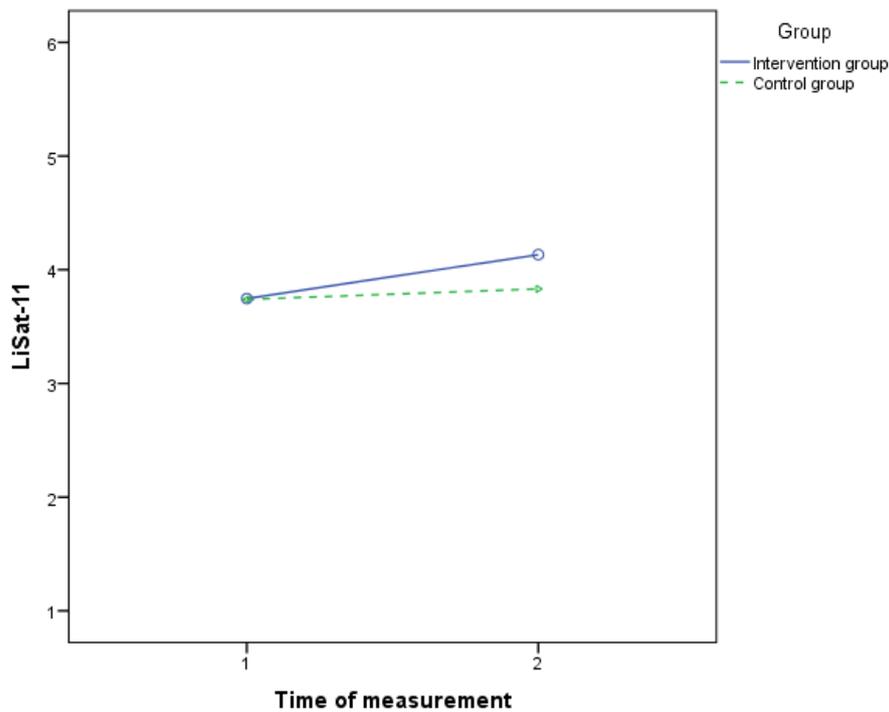


Figure 9. Pre and post measurement means for the intervention and control group on the LiSat-11.

### Discussion

The purpose of this study was to examine whether an online mindfulness training program could serve to reduce the experience of pain in individuals suffering from chronic pain. After completing the program the participants showed decreased pain intensity and reduced levels of interference of pain in their everyday lives. They also exhibited less affective distress as well as greater acceptance of and a decreased level of distress caused by pain. Furthermore, their quality of life improved and as expected, they showed increased levels of mindfulness. By contrast, the control group did not exhibit higher levels of mindfulness which indicate that the improvements in the intervention group were in fact derived from the mindfulness training. Thus, the mindfulness training program was demonstrated to be effective both in regard to reduction of the pain-related experiences and to improve aspects of life that could be negatively affected by pain.

The decreases in pain were not completely unanimous, though. When measured by a single item asking for an average of pain during the past week the result did not show significantly lower levels of pain intensity in the intervention group even though a strong tendency ( $p = 0.77$ ) towards reduced pain was found. In previous research there is no agreement regarding the effect mindfulness has on pain intensity. In their review Reiner et al. (2013) found that mindfulness has an effect on pain intensity while Chiesa and Serretti (2011) were unable to confirm this in

their review. The reviews differed in what kind of pain measures they included. Chiesa and Serretti as well as Veehof et al. used both multidimensional and unidimensional measures of pain while Reiner et al. only reviewed studies that had used unidimensional measures of pain.

When measured by the pain severity subscale of the brief screening version of the MPI-S a significant decrease in pain intensity at a medium effect size was revealed. The subscale consists of a composite of two questions, one regarding average pain during the last week and one regarding current pain. We hypothesize that the inclusion of an item regarding current pain could be related to the lower results on the pain ratings compared to the unidimensional NRS. The emphasis on the present moment that is central in mindfulness could be an important aspect to consider when understanding this result. An active component in mindfulness training for chronic pain according to Reiner et al. (2013) could be detachment of cognitive and emotional pain components (Reiner et al., 2013). The experience of pain in the present moment would then not be aggravated by thoughts and feelings about it.

The other subscales in the brief screening version of MPI-S measures other important aspects of chronic pain, such as its effect on everyday life (Jakobsson, 2009). The scores on the two subscales affective distress and interference improved significantly in the intervention group compared to the control group indicating that the mindfulness program has a positive effect on the experience of pain. No significant improvements in the subscale life control were found.

The lack of significant improvement on the single item regarding average pain during the past week goes in line with the results of Cusens, Duggan, Thorne and Burch (2010) who also failed to find a significant decrease in pain intensity ratings. They hypothesized that this could be related to the Breathworks' program as it has an emphasis on acceptance and absence of explicit attempts to decrease pain. As the mindfulness program used in the present study is an adaptation of the Breathworks' program the same explanation could apply here as well. Veehof et al. (2011) concluded that in interventions for chronic pain the pain, due to its chronic nature, is unlikely to decrease much.

Therefore, other aspects than pain intensity are also relevant when assessing the experience of chronic pain. Acceptance of chronic pain has been associated with several health benefits such as less disability and better work status (McCracken & Eccleston, 2003). After program completion, acceptance of pain increased for the participants in the intervention group. As the mindfulness program largely is directed towards increasing acceptance of pain through mindfulness this is not surprising. After completing the program participants showed increases in both overall acceptance and activities engagement.

Increased engagement in activities can be valuable for individuals with chronic pain as the condition often is associated with withdrawal from previously valued activities (Vlaeyen & Linton, 2012). McCracken, Vowles and Eccleston (2004) suggest that an important component of acceptance of chronic pain is engagement

in positive everyday activities even when experiencing pain. Thus, acceptance of chronic pain is not only limited to mental processes. Another component of chronic pain acceptance is the realization that avoidance of, or attempts to control pain are ineffective ways of coping as they do not decrease pain (McCracken, Vowles & Eccleston, 2004). The participants in the present study did not show significant change in pain willingness though. Both intervention and control group reached significantly higher means in the post measurements but the interaction effects were not significant. However, the mean scores derived from the pain willingness subscale are relatively high in both pre and post measurement compared to the reported means in previous studies (e.g. Vowles, McCracken, McLeod & Eccleston, 2008), constituting for an even result when considered in relation to the activities engagement subscale.

After completing the mindfulness program the participants exhibited significantly reduced levels of distress caused by pain. This is an important finding as decreases in distress due to pain can be viewed as an indicator of the impact of the mindfulness training on the individuals' everyday lives. Based on the findings in the present study we hypothesize that decreases in distress due to pain can be related to increased quality of life, thus affecting the overall experience of life for the individual. The reduction in distress could also be related to the increase in acceptance of pain that the participants exhibited in the present study. As proposed by McCracken and O'Brien (2009), people with chronic pain might feel less distress when they are able to experience unpleasant sensations without attempting to control them. Mindfulness training could lead to such an attitude as it is educating a nonjudgmental and accepting position towards pain.

As chronic pain is associated with decreased quality of life (Breivik et al., 2006; Lamé, Peters, Vlaeyen, Kleef & Patijn, 2005) it is an important aspect to consider when evaluating an intervention for chronic pain. In the present study, the intervention group increased their life satisfaction compared to the control group. This is in accordance with previous research (Chiesa & Serretti, 2011). The effect size was at a medium level which is the same as Veehof et al. (2011) found in their meta-analysis.

The use of a discussion forum for the control condition can be considered as a form of active control group, which is preferable to a simple waiting-list condition (Boot, Simons, Stothart & Stutts, 2013). It is also needed in research on mindfulness and chronic pain (Reiner et al., 2013). The participants in the control group were informed that a previous study (Lorig et al., 2002) had shown that a discussion forum can have a positive effect on the experience of pain, thus giving them some expectation of positive effects. Providing the control group with information that might increase their expectations to benefit from the control condition is recommended by Boot, Simons, Stothart and Stutts (2013) as it is considered a way of removing potential placebo effects. We did not measure expectations in the present study however, thus making it difficult to clearly state that the control group had equal expectations as the intervention group.

Some limitations of the current study should be noted. Many participants had previous mindfulness experience which may have affected the results. If the participants already were mindful before participating in the present study they could already exhibit high levels of the skills that are trained in mindfulness. Thus, generalizability of the findings needs to be further investigated in pain groups without previous mindfulness experience. However, the constitution of the sample also has some strength, since it does not only consist of chronic pain patients the results are not limited to this group. This is lacking in some previous studies according to Reiner et al. (2013). Turk and Okifuji (2002) also point out the importance of investigating treatments for chronic pain on individuals that do not seek help since treatment effect may not be the same in these individuals.

As we excluded participants with high levels of depression which is a common comorbid diagnosis to chronic pain the generalizability of the present study could be compromised. However, even though mindfulness is considered an applicable method of preventing depression it has been considered less useful in patients with current depression as they might exhibit cognitive deficits due to their depressive state making it difficult to acquire the skills taught through training (Segal, Williams & Teasdale, 2002). The participants' ability to complete the program can also be negatively affected by a depressive state. More recent research has found positive effects on depression after mindfulness training online (Krusche, Cyhlarova & Williams, 2013), but this is not yet sufficiently researched.

The drop out rates in this study were high (60%), due to which some caution when interpreting the results is needed. The high drop out rates implies difficulties in completing the program for the participants. Large drop out rates are common in Internet-based studies in which none or little personal contact is included (Melville, Casey & Kavanagh, 2010). We hypothesize that more participants would have completed the program if some form of personal support or contact had been provided or if the participants had been able to participate in a discussion forum related to pain and mindfulness during the intervention. It can be noted that 71% of the 21 participants who completed the program reported no previous mindfulness experience. Therefore it can be assumed that, in order to complete the mindfulness program, no previous experience of mindfulness is needed. The fact that 93% of the participants were female is noteworthy even though we do not believe that this affected the results in any particular way.

A plausible explanation to the large drop out in the intervention group could be that the participants did not experience improvements in the early stages of the program and therefore discontinued the program. On the other hand, experiences of early improvement could result in premature drop out as the participants might not feel the need to continue the program. Furthermore, the large drop rate could to some extent be due to technical problems with the mindfulness program, which, for a few days, made the participants unable to progress in their mindfulness training.

Acceptance seems to be an important aspect of the mindfulness program in decreasing pain related suffering. In order to gain further understanding of the connection between mindfulness and pain, future research should focus on investigating whether certain components in mindfulness training, such as acceptance, carries specific importance for reducing pain and pain-related problems.

The goal in acceptance based interventions for chronic pain is not specifically reduced pain but rather a new way of dealing with pain. Our results support the notion that individuals suffering from chronic pain can benefit from mindfulness training. In conclusion, the mindfulness program used in the present study seems to be an effective way of increasing levels of mindfulness as well as pain related acceptance and, to some extent, also decrease pain. As the mindfulness program was administered online, without any personal contact it is a cost-effective option or complement to other types of treatments for the disabling disease that is chronic pain.

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