

Mindfulness Meditation for the Treatment of Chronic Low Back Pain: A Preliminary Quasi-Randomized Controlled Pilot Study

Cesare Lino^{1,2*}, Stefan Neuwersch-Sommeregger², Rudolf Likar³, Paola De Bartolo^{4,5}

¹Department of Human Sciences, Guglielmo Marconi University, Rome, Italy

²Department of Centre for Interdisciplinary Pain Therapy, Oncology and Palliative Care, Klinikum Klagenfurt Am Worthersee, Austria

³Department of Anaesthesia and Intensive Care Medicine, ZISOP Centre of Interdisciplinary Pain Therapy and Palliative Care, Klinikum Klagenfurt Am Worthersee, Austria

⁴Department of Human Sciences, Guglielmo Marconi University, Rome, Italy

⁵Lab of Experimental Neurophysiology, IRCCS Fondazione Santa Lucia, Rome, Italy

Research Article

Received: 12/11/2021

Accepted: 26/11/2021

Published: 03/12/2021

***For Correspondence:** Cesare Lino, Department of Human Sciences, Guglielmo Marconi University, Rome, Italy

E-mail: cesare.lino@gmail.com

Keywords: Chronic pain; Mindfulness; MBPT; MBSR; Meditation; Multimodal pain management; Low back pain

ABSTRACT

Background: To investigate the effectiveness of Mindfulness-Based Pain Therapy (MBPT) a treatment combining mindfulness meditation and several interventions taken from cognitive therapy within the frame of the multimodal pain therapy program, in patients suffering from chronic low back pain (CLBP).

Methodology: The study included 20 subjects with chronic low back pain were recruited and quasi-randomly allocated to a standard multimodal pain therapy (n=10) or to a multimodal pain therapy group with MBPT (n=10). The intervention was identical for both groups except for the mindfulness meditation program. Both groups participated in 4-week training, 5 times/week. All subjects underwent the same measurement protocol before and after the intervention. The program was evaluated on the basis of measure of pain, quality of life, disability, pain catastrophizing and depression.

Results: The trial group displayed significant reduction in pain intensity, improvement in the quality of life, reduction in pain disability, in depression and pain catastrophizing.

Conclusion: The study indicated that mindfulness meditation can influence the treatments and lead to a significant improvement in the overall result of the multimodal pain therapy.

ABBREVIATIONS

MBI: Mindfulness-Based Interventions; MBPT: Mindfulness-Based Pain Therapy; MBSR: Mindfulness-Based Stress Reduction; CLBP: Chronic Low Back Pain

INTRODUCTION

Chronic pain, defines as pain lasting longer than 12 weeks or past the normal time for tissue healing ^[1] is defined as an unpleasant sensory and emotional experience (IASP taxonomy 2012). It has a huge impact on the quality of life of the more than 1.5 billion people around the world who are living with this condition, with prevalence increasing with age ^[2]. Chronic pain is a challenge for health care systems and a leading cause of disability in the world ^[3]. In Europe it affects 20% of the population ^[4] with total cost estimated to be in the region of 3% to 10% of gross domestic product ^[5]. Chronic pain is therefore a global public health problem and has an unquestionable impact upon a patient's quality of life and is linked to lower quality of life ^[6]. Although drugs, particularly opioids, are highly effective, their sole use, especially in the management of chronic non-malignant pain remains controversial ^[7] and with undesirable side effects. They are not always a remedy and should not be used alone but form part of a multidimensional strategy that as well as analgesics includes non-pharmacological approaches, such as physical and psychological therapy and alternative therapies ^[8].

Comprehensive multidisciplinary pain management based on the bio psychosocial model of pain has been shown to be clinically effective and cost-efficient ^[9] although the treatment is not always satisfactory ^[10]. Multimodal pain management is defined as a comprehensive treatment of complex chronic pain syndromes, in which medical therapy is integrated with various other specialized therapeutic interventions provided by specialists from various areas of expertise, such as doctors, physiotherapists and psychologists based on the bio psychosocial model ^[11]. The treatment involves a combination of physical exercise, patient education, relaxation techniques and medication ^[12]. The high pervasiveness and the persevering nature of chronic pain have led to increased interest in treatment plans which include alternative interventions, such as mindfulness meditation ^[13]. Mindfulness is defined as the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment ^[14]. Based on ancient Eastern meditation practices, mindfulness has in the last three decades achieved increasing interest as an integrative and alternative treatment for managing chronic pain. Historically a Buddhist practice, mindfulness can be considered a universal human capacity proposed to cultivate clear thinking and openheartedness ^[15]. It is a mind state characterized by paying conscious attention to the moment-to-moment experience with acceptance and openness ^[16]. Mindfulness meditation includes a variety of techniques that help focus attention in a non-judgmental way and avoid ruminative, persistent, or obsessive thinking. One of the goals of mindfulness is to allow thoughts to arise and to fade away, without meditators being emotionally "caught up" by their contents ^[17]. Mindfulness was originally proposed as a clinical intervention utilized in the management of chronic pain and stress ^[18]. Subsequently numerous interventions based on mindfulness have been developed encompassing from programs for patients with cancer to those with mental health problems ^[19]. Since then research on mindfulness-based interventions (MBI) has increased exponentially. Mindfulness-Based Stress Reduction (MBSR), currently the most widely implemented meditation intervention regarding chronic pain, has been found to promote significant reductions in chronic pain ^[20], enhancement in emotion regulation as well as it can improve mental health ^[21]. This research compared MBPT with usual multimodal chronic pain management. We hypothesized that patients with CLBP would show greater improvement in several measures such as disability, pain intensity, pain catastrophizing and other outcomes compared to those who received the usual care.

MATERIALS AND METHODS

20 outpatients (women=15, men=5) with chronic low back pain (CLBP) were recruited by referrals from the hospital's internal pain, orthopedic and neurological clinics, general practitioners and specialist doctors. The MBPT group was significantly younger (43 ± 7.15 years) than the control group (54.5 ± 8.54 years, $p < 0.026$ U-Test).

Intervention

Mindfulness-Based Pain Therapy (MBPT) is a program modeled by the first author after the curriculum developed by Kabat-Zinn et al. at the Stress Reduction Clinic of the University of Massachusetts Medical Center. As other mind-body approaches, MBPT focuses on increasing awareness and acceptance of present experience including physical distress and challenging thoughts and emotions. Participants underwent individual intake interviews prior to admission in MBPT during which a short medical history was taken as well as informed consent procedures for participation in outcome research. Baseline measures were also obtained. Exclusion criteria included substance abuse, pregnancy, cognitive impairment, language barrier and severe mental disorders (such as psychotic symptoms). All participants were given usual medical care during the intervention. Patients had no previous meditative experience. The intervention took place at the General Hospital of Klagenfurt am Worthersee in Austria. The study was approved by the medical ethics committee of the hospital of Klagenfurt am Worthersee (Austria) (A12/19). All methods were performed in accordance with the relevant guidelines and regulations.

Frequency and setting: MBPT-group was delivered by the first author, who is a MBSR trainer with extensive meditation teaching experience. An observing psychologist was also present at each session. The control group was delivered by two licensed clinical psychologists of the general hospital of Klagenfurt with extensive experience in the multimodal pain therapy. 10 chronic pain patients (CLBP) were trained daily (2 h) in mindfulness meditation over a period of 4 weeks whilst the control group attended the standard multimodal pain management consisting of psychological group therapies, pain management and relaxation training, stress management training. Both groups received, from 8:00 a.m. to 12:00 a.m. medical therapies, coordination and endurance strength training as well as medical and psychological individual consultations. Due to the relatively small number of participants available at a single time, it was not feasible to assign the participants randomly. For this reason, the allocation to treatment was based according to time of enrollment. The first 10 patients who enrolled were allocated to the control group, whereas the following 10 patients formed the MBPT-group.

Program techniques: The intervention was modeled closely by the first author after the MBSR program as taught at the University of Massachusetts Medical Center [22] and was delivered according to a manualized protocol. The MBPT program focuses specifically on chronic pain and involves a variety of mindfulness meditation techniques including: mindful breathing, body scan, mindful yoga, walking meditation, awareness of emotions and loving kindness meditation (metta) practices as well as several techniques taken from cognitive therapy. Yoga was tailored to accommodate patients with chronic low back pain. MBPT differs from other mindfulness-based interventions (MBI) in that it entails more intensive daily meditative practice (at least 1 hour/day) 5 days per week. Moreover, participants were instructed to practice informal meditation, like being mindful in everyday activities (e.g. eating, walking, etc.). Daily class was divided between meditation practice, group discussions (in dyads or group). Written materials and recordings of guided meditations were provided, although participants were not explicitly instructed to practice at home. The didactic content included education about chronic pain, stress, sleep hygiene, functional and maladaptive pain-coping strategies, and dysfunctional thoughts.

Adherence: One patient dropped out of the experimental group and one from the control group. Both dropped out due to unexpected family obligations. Program completion rate was very high (90%) a rate consistent with other studies [23]. Compliance to MBPT class attendance was very high. Of a total of 19 classes only 3 patients missed one class.

1- and 3-month follow-up: Of the 9 participants in the experimental group who completed the MBPT program 7 were available for 1-month and 3-month follow-up. In the control group 8 were available for 1-month follow-up and 7 for the 3-month follow up.

Data analysis: Descriptive statistics were used for the variables between MBPT group and control group. Appropriate parametric or non-parametric tests were done. Variables were compared by U-test (Wilcoxon rank-sum test) resp. 2-sample t test (Welch test) in case of normally distributed data. Normality was investigated by Kolmogoroff-Smirnov test. The progression of the differences of the medians over the measurement time points was tested with the signed-rank test. Spearman rank correlation coefficient was calculated to examine association between scores. Significance was defined as a p value less than 0.05 p values are reported to a maximum of three decimal places. For all calculations the statistical package R version 4 resp. Hewlett-Packard RPL version 2.08 were used.

Measures

Numerical pain rating scale: The Numerical Pain Rating Scale (NRS) is commonly used in clinical population in order to measure the intensity of pain. Patients choose before and after each session the number that best reflects the intensity of the pain, with 0 representing “no pain” and 10 indicating “worst pain imaginable”. Several studies provide evidence for its reliability and validity [24,25].

EuroQol 5-D: The EuroQol-5D (EQ-5D) questionnaire is an instrument which assesses health status. The EQ-5D comprises two components: Health state description and evaluation: The EQ-5D-description is a self-reported explanation of health problems according to a five-dimensional classification (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) [26]. In the EQ-5D-evaluation, the respondents report their health status using a visual analogue scale (VAS), comparable to a thermometer. Chronic pain is associated with overall decreased quality of life. The scale is graduated from 0 (the worst imaginable health state) to 100 (the best imaginable state). EQ-5D showed a good responsiveness to change after different interventions for CLBP patients [27].

Pain perception scale (PPS): The Pain Perception Scale (PPS) [28] allows a differentiated assessment of perceived pain. It permits measurement of the emotional characterization and the sensory characterization of pain, uncoupling the physical sensation from the emotional and cognitive experience of pain [29]. The questionnaire contains 24 items assigned in 5 subscales.

Pain disability index: The Pain disability index (PDI) [30] is a self-report questionnaire which investigate how much pain interferes in different areas of patient’s life activity: such as family/home, recreation, social, occupation, sexual, self-care, life-support and average. The respondent uses a scale ranging from 0 (no disability) to 10 (maximum disability). The German PDI confirmed a good reliability and validity [31].

Beck depression inventory II: Beck Depression Inventory II is a widely used 21-item self-report inventory for measuring the severity of depression [32]. Numerous studies provide evidence for its reliability and validity [33]. The German BDI-II shows good reliability and validity in clinical population [34].

Pain catastrophizing scale: Pain Catastrophizing Scale PCS is a 13-item questionnaire that assesses catastrophizing, viewed as a multidimensional construct comprising rumination (“I can’t stop thinking about how much it hurts”), magnification (“I worry that something serious may happen”) and helplessness (“There is nothing I can do to reduce the intensity of the pain”) [35]. The score ranges from 0 to 52. The German PCS represent a valuable tool in the assessment of German-speaking clinical population [36].

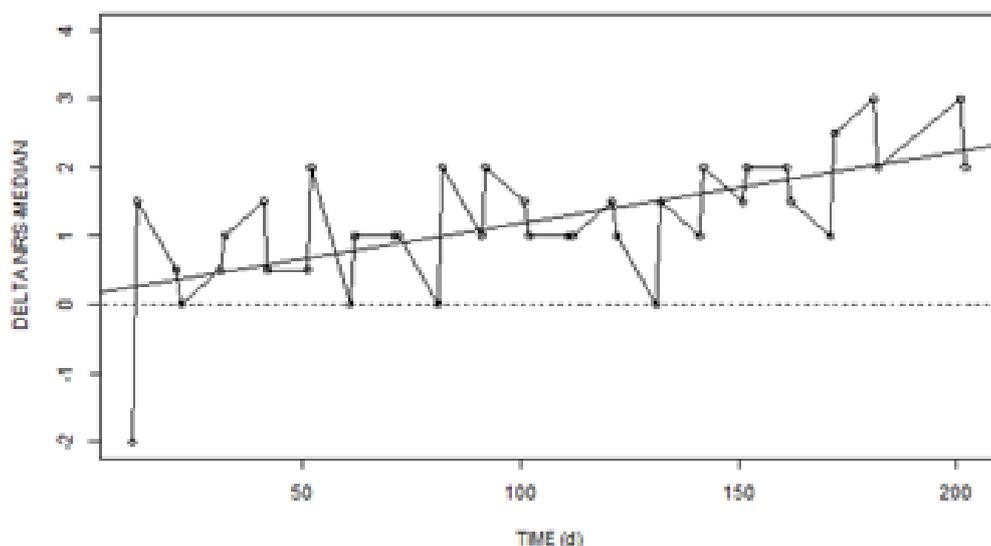
RESULTS

At baseline, treatment groups were similar in pain characteristics.

Numerical pain rating scale

The differences in the NRS score medians (control group minus intervention group) were measured both before and after the therapy sessions (19 measurement points each). These differences are highly significantly positive in both cases ($p < 0.01$; signed rank test). The MBPT group demonstrates a significant decrease in pain intensity from baseline comparing with control group. Results indicate that pain intensity reduction was maintained over 1-month to 3-month follow-up periods. The difference in the score medians (control group minus MBPT group) increases over time; the increase is highly significant. The correlation coefficient between the median differences and the survey points in time was calculated (Spearman- ρ): $\rho = 0.63$, ($p < 0.01$) (Figure 1).

Figure 1. Time progression of the NRS median differences. MBPT patients have highly significant lower pain scores ($p < 0.01$; signed rank test).



EuroQol 5-D: In the EQ-5D-evaluation, the MBPT-group reported a significant improvement. The patients of the experimental group declared an increase in quality of life from 50% (pre) to 85% (post) and after three months it settled at 75%, against a marginal increase in the control group (Pre: 45% Follow-up at 3 months: 50%) (Table 1). The value in the follow-up at 1 month is statistically significant ($p = 0.036$; U test) as well as the time progression of median differences ($p = 0.015$; one sample t-test). However, when comparing the single subscales of the two groups, differences were not significant (Figure 2).

Figure 2. Trend of the EQ Thermometer medians for MBPT group (•) and control group: (◊). The values at POST differ weakly significantly ($p=0.095$; U test), the values of the follow up at one month differ significantly ($p=0.036$; U test).

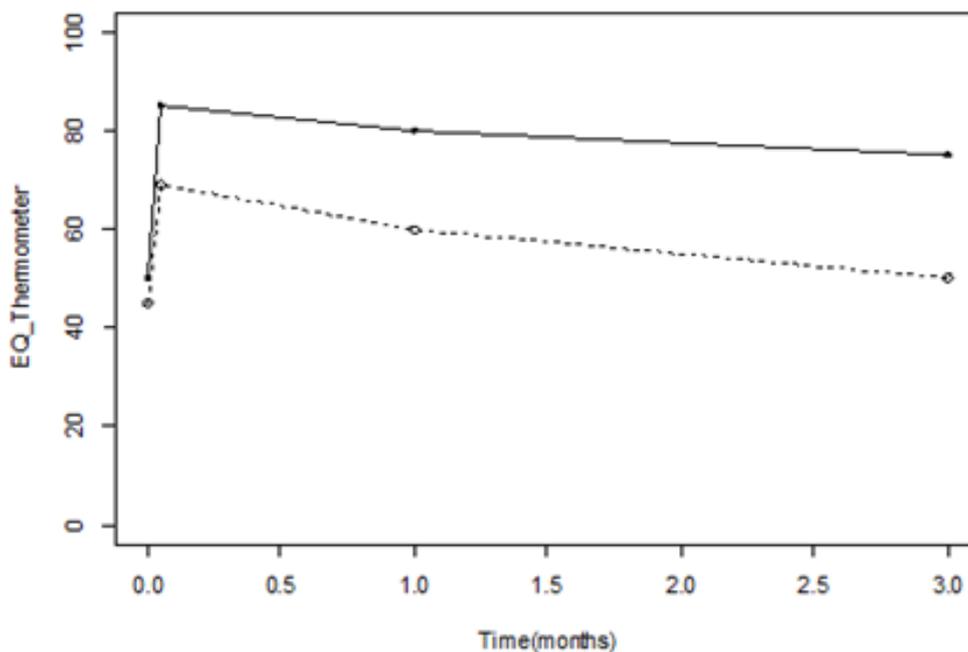


Table 1. EuroQol 5-D.

EQ 5D Evaluation	Control group				MBPT group			
	N	Median	Mean	SDEV	N	Median	Mean	SDEV
Pre	10	45	51.8	19.1	10	50	47.3	12.4
Post	9	69	66.1	17.8	9	85	74	24
1-Month	7	60	58.7	15.3	8	80	75.3	18.3
3-Month	7	50	56.6	20.9	7	75	71.4	20.1

Pain perception scale PPS

The MBPT-group has consistently lower values than the control group, in some cases significant (post) ($p=0.01$ or $p=0.03$; exact U-test) (Tables 2 and 3) (Figures 3 and 4).

Pain disability index

Significant changes in pain-related disability were observed in the MBPT-Group immediately at post and at 1 month ($p=0.03$ and 0.04 , exact U-test) (Table 4) and (Figure 5).

Beck depression inventory

Although the differences at the single measurement points are not significant, the progressive increase of the median differences between the two groups is remarkable (Table 5) (Figure 6).

Figure 3. Trend of SES_A medians for MBPT group (•) and control group (◦). The groups differ significantly at POST ($p=0.012$, U test).

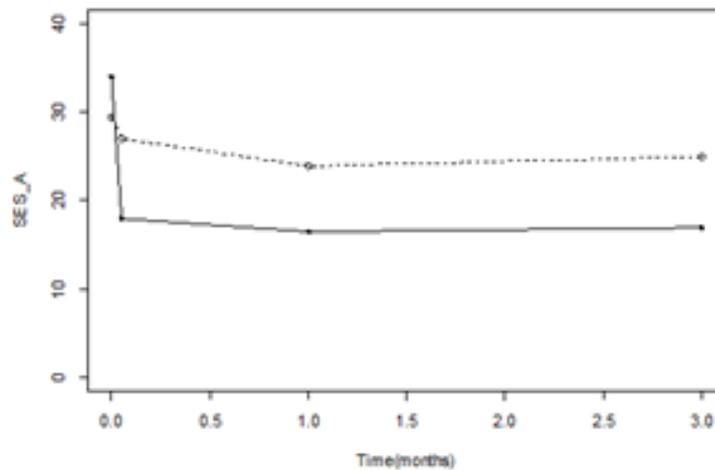


Figure 4. Trend of the SES_B medians for MBPT group (•) and control group (◦). The groups differ significantly at POST ($p=0.025$, U test).

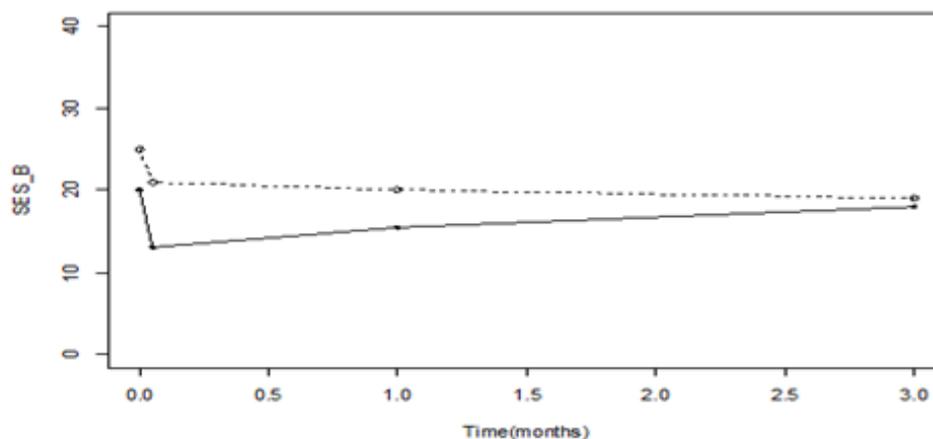


Table 2. Pain Perception Scale–Affective.

Affective	Control group				MBPT group			
	n	Median	Mean	SDEV	N	Median	Mean	SDEV
Pre	10	29.5	32	11	9	34	35	11.2
Post	9	27	26	7.2	9	18	19.4	4.3
1-Month	6	24	23	3.8	8	16.5	19.8	7.6
3-Month	7	25	25.6	8.4	7	17	19.6	5.2

Table 3. Pain Perception Scale–Sensory.

Sensory	Control group				MBPT group			
	n	Median	Mean	SDEV	N	Median	Mean	SDEV
Pre	10	25	24	6.8	10	20	23.8	7.6
Post	9	21	20	5.1	9	13	14.8	4.1
1 month	7	20	19.6	6.9	8	15.5	16.8	6.1
3 month	7	19	20.1	6.9	7	18	17.4	5.4

Figure 5. Trend of PDI medians for MBPT group (•) and control group (◦). The groups differ significantly at one month (p=0.025, U test). And three months (p=0.036, U test).

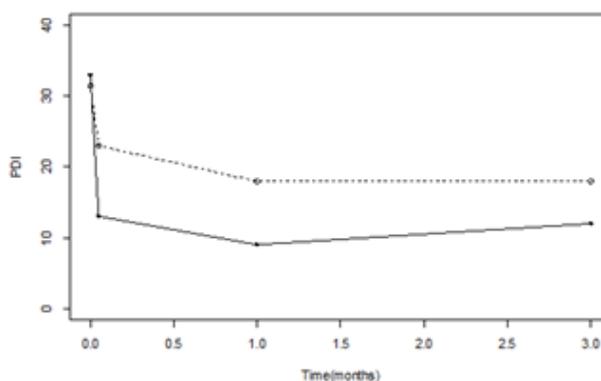


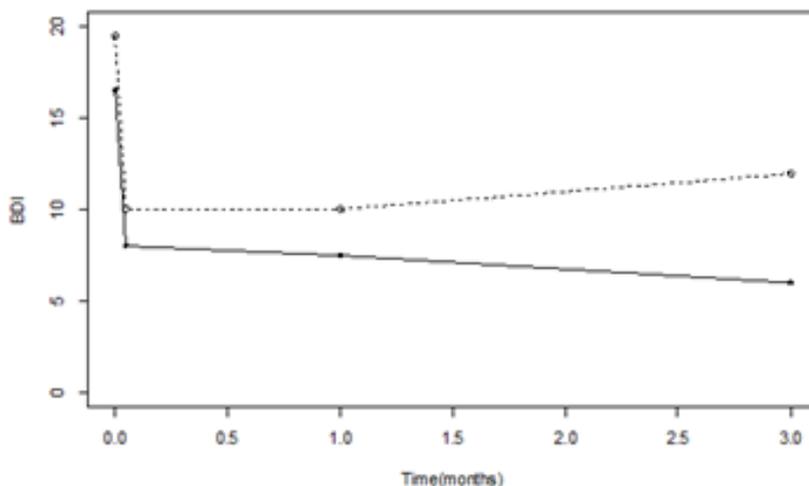
Table 4. Pain disability index.

PDI	Control group				MBPT group			
	n	Median	Mean	SDEV	n	Median	Mean	SDEV
Pre	10	31.5	29.1	8.2	10	33	32.3	12.3
Post	9	23	22.2	9.6	9	13	13.2	7.4
1-Month	7	18	23.1	11.8	7	9	13	10.6
3-Month	7	18	15.4	10.1	7	12	14.7	12.1

Table 5. Beck depression inventory.

Spaltentitel	Control group				MBPT group			
	N	Median	Mean	SDEV	n	Median	Mean	SDEV
Pre	10	19.5	18.7	9.9	10	16.5	15.8	6.2
Post	9	10	11.6	11.4	8	8	7.6	6.3
1-Month	7	10	7.9	5	8	7.5	8.8	8.4
3-Month	7	12	11.6	7.6	7	6	9.1	9.2

Figure 6. Trend of BDI medians for MBPT group (•) and control group (◦). Differences between the groups are not significant.



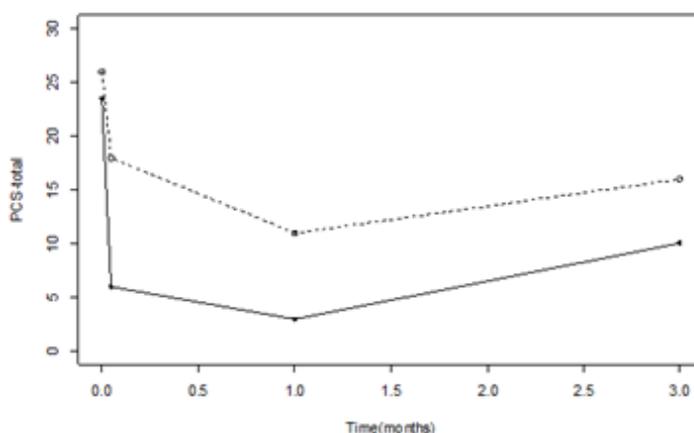
Pain catastrophizing scale

The MBPT group demonstrates a significant decrease in pain catastrophizing value from baseline compared with control group. Results indicate that pain catastrophizing reduction was maintained over 1-month to 3-month follow-up periods (Table 6 and Figure 7).

Table 6. Pain catastrophizing scale.

PCS	Control group				MBPT group			
	n	Median	Mean	SDEV	n	Median	Mean	SDEV
Pre	10	26	24.2	11.1	10	23.5	24.9	11
Post	9	18	15.6	9.4	9	6	7.7	8.2
1-Month	7	11	12.6	6.5	9	3	7.9	7.8
3-Month	7	16	14.9	10.5	7	10	10.9	9.2

Figure 7. Time progression of the PCS medians of the two therapy groups (therapy group: •, control group: ◦). The two groups differ significantly in PCS-total post (p=0.047; exact U-test).



DISCUSSION

Although several studies have examined the effects of mindfulness on chronic pain [37,38], to our knowledge, this is the first study to evaluate the feasibility of an intensive mindfulness-based meditation program within the multimodal pain therapy. We hypothesized that mindfulness intervention in the multimodal pain therapy would ameliorate the results of the standard multimodal pain treatment. Results supported the hypotheses. We found that MBPT Program within multimodal pain management was associated with better pain management compared to the control group. It also provided evidence of increases in well-being and quality of life as well as decreases in pain intensity, disability, depression and catastrophizing. The completion rate was very high in both groups.

A decrease in pain intensity in the intervention group was highly significant, as well as the reported quality of life increased. Further, significant effects were observed in reduction of the disability. The findings suggest that MBPT is more effective than multimodal standard therapy alone in significantly improving quality of life, reducing disability, depression and catastrophizing related to chronic pain. These effects were partly maintained at 3-month follow-up. Patients with chronic pain may profit from mindfulness meditation through various mechanisms.

In line with Holzel et al. we assume that the positive effects of mindfulness on chronic pain can be attributed to different mechanisms [39]. Attention regulation, body awareness, emotion regulation through acceptance and change in perspective on the self.

Attention regulation

Attention regulation is central to many mindfulness-based interventions. Attention can be metaphorically described as a constantly moving spotlight which illuminates certain aspects of the experience, leaving others in the darkness. Patients with chronic pain frequently have their attention selectively focused on their pain (attention bias) [40] investing a considerable amount of time ruminating on their pain, its causes and consequences. Mindfulness meditation aims to counterbalance these tendencies by stabilizing attention skills. It has been postulated that mindfulness reduces depressive symptoms by lowering the process of thinking perseverative about one's feelings and problems [41].

Body awareness

Some authors reported altered body awareness in chronic pain patients [42] and a positive correlation between body awareness and mindfulness [43]. Mindfulness may contribute in disengaging from selective pain-related perceptions, offering a broader perspective to the person allowing a wider range of experience, as opposed to a narrowed focus on the perceptual field of the pain. Some patients reported, for example: "I realized that besides the pain in my back I have other sensations, some of them even pleasant".

Emotion regulation through acceptance

There is a considerable amount of evidence that the process of trying to control the experience of chronic pain (avoidance) can lead to an exacerbation of the perception of pain [44]. At the same time maladaptive emotion regulation can be an important risk factor in the development and maintenance of chronic pain [45].

At the opposite pole, acceptance seems to be a factor that significantly influences patients' emotion regulation and thus quality of life. Acceptance is associated with lower pain intensity, less pain-related anxiety, less physical and psychological disability [46]. More over pain catastrophizing has been found to be an inverse correlate of acceptance [47]. Letting go of struggle and acceptance of one's condition without judgment is a critical concept in the mindfulness-based interventions. We define acceptance as an allowing and open-minded stance toward all experience particularly those which are unwanted and unchangeable. Acceptance allows an understanding of

reality as it is and helps to avoid the extremes of unproductive resistance and passive resignation and enables a realistic assessment of one's own possibilities in the present moment. Acceptance is the attitude of understanding that things are not always as one would like them to be. It is neither approval nor resignation to the reality of things as they actually are. Some participants reported, for instance, that accepting their situation allowed them to discover new coping strategies of responding to pain (empowerment). Others stated for example: "I learned new ways to deal with my pain."

Change in perspective on the self

Chronic pain interferes commonly with essential life goals of the patients and may have profound impact on patient's sense of self. Patients frequently reported feeling useless, unable to pursue their personal plans. Statements such as: "my life is a catastrophe" or "am not able to manage my pain" were very common among the groups. During the program we could see, consistent with the findings of other authors ^[48] a remarkable change in perspective. Some patients stated for example: "I am not my pain" or "my pain does not define me" or "I learned to deal with my pain" showing a radical change in the way the patient relates to his own condition. Some authors have termed this process "perceiving" or "decentering" ^[49].

We believe the positive impact on the assessed measures was partly due to the sum of time of practice, which could be with better results. In our study participants of the MBPT-Group had an intensive daily practice (2 h).

Despite overall promising results, it is noticeable that there was no significant difference between MBPT-Group and control group in some fundamental measures such as mindfulness levels, measured with Five Facet Mindfulness Questionnaire (FFMQ). This could have several reasons. We speculate that both groups may have gained through the physical activity a certain degree of mindfulness ^[50]. Furthermore, the study did not observe significant differences in sleep quality when MBPT was compared to the control group, although other studies have found a positive correlation between mindfulness and sleep quality ^[51].

LIMITATIONS

Results of the current study should be interpreted in light of several limitations. The study was not strictly randomized and had a small sample size. Stratification by age should have been applied in order to ensure equal allocation of participants.

CONCLUSION

In summary the MBPT-Program represents a meaningful and feasible non-pharmacologic addition to the current multimodal treatment for chronic pain. We suggest that utilizing mindfulness meditation (e.g. MBPT) adjunctively with standard multidisciplinary treatment can lead to greater efficacy of the treatment and as a result appears promising and a viable alternative for the treatment of chronic low back pain. More research is needed on larger samples, which may achieve more significant results. Future studies may examine the mechanisms by which mindfulness interventions reduce pain.

REFERENCES

1. Classification of chronic pain. Descriptions of chronic pain syndromes and definitions of pain terms. Prepared by the International Association for the Study of Pain, Subcommittee on Taxonomy. Pain Suppl. 1986; 3:226.
2. International Association for the Study of Pain: "The Relief of Pain Should Be a Human Right".
3. Phillips CJ. The Cost and Burden of Chronic Pain. Rev Pain. 2009; 3(1): 2-5.
4. Breivik H, et al. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain.

- 2006; 10: 287–333.
5. Breivik H et al. The individual and societal burden of chronic pain in Europe: the case for strategic prioritisation and action to improve knowledge and availability of appropriate care. *BMC Public Health*. 2013; 13: 1229.
 6. Geneen LJ, et al. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. *Cochrane Database Syst Rev*. 2017; 1(1):CD011279.
 7. Savage SD. Long-term opioid therapy: Assessment of consequences and risks. *J Pain Symptom Manage*. 1996; 11 (5)1996; 274-286.
 8. Mills' S, et al. Identification and Management of Chronic Pain in Primary Care: a Review. *Curr Psychiatry Rep*. 2016; 18: 22.
 9. Dysvik E, et al. The effectiveness of a multidisciplinary pain management program managing chronic pain on pain perceptions, health-related quality of life and stages of change – a nonrandomized controlled study. *Int J Nurs Stud* 2010; 47: 826-835.
 10. Dale R, et al. Multimodal treatment of chronic pain. *Med Clin North Am*. 2016; 100(1): 55–64.
 11. Arnold B, et al. Multimodal pain therapy for treatment of chronic pain syndrome. Consensus paper of the ad hoc commission on multimodal interdisciplinary pain management of the German Pain Society on treatment contents. *Schmerz*. 2014; 28(5): 459-472.
 12. Arnold B, et al. Multimodale Schmerztherapie. *Schmerz*. 2009; 23: 112.
 13. Kabat-Zinn J. Full catastrophe living: how to cope with stress, pain and illness using mindfulness meditation. London: Piatkus, 1996.
 14. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Am Psychol Assoc*. 2003; 10 (N2): 144–156.
 15. Kabat Zinn J, et al. Mindfulness in Medicine. *JAMA*. 2008; 300:1350-52.
 16. Brown KW, et al. The benefits of being present: Mindfulness and its role in psychological well-being. *J Pers Soc Psychol*. 2003; 84(4): 822–48.
 17. Krygier JR, et al. Mindfulness meditation, well-being, and heart rate variability: A preliminary investigation into the impact of intensive Vipassana meditation. *Int J Psychophysiol*. 2013; 89 (3): 305-13.
 18. Kabat Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: theoretical considerations and preliminary results. *Gen Hosp Psychiatry*. 1982; 4(1):33-47.
 19. Baer RA. Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clin Psychol Sci Prac*. 2003; 10(2): 125–143.
 20. Hilton L, et al. Mindfulness Meditation for Chronic Pain: Systematic Review and Meta-analysis. *Ann Behav Med*. 2017; 51 (2): 199–213.
 21. Goyal M, et al. Meditation Programs for Psychological Stress and Well-being: A Systematic Review and Meta-analysis. *JAMA Intern Med*. 2014; 174(3): 357–368.
 22. Santorelli SF, et al. Mindfulness-Based Stress Reduction (MBSR) Authorized Curriculum Guide.2017.
 23. Kabat Zinn J, et al. Compliance with an outpatient stress reduction program: rates and predictors of program completion. *J Behav Med*. 1988; 11: 333–352.
 24. Childs JD, et al. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine*. 2005; 30(11): 1331-34.

25. Michener LA, et al. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. *J Sport Rehabil.* 2011; 20(1): 115-128.
26. EuroQol Group. EuroQol: a new facility for the measurement of health-related quality of life. *Health Policy* 1990; 3: 199-208.
27. Soer R, et al. Clinometric properties of the EuroQol-5D in patients with chronic low back pain. *Spine.* 2012; 12(11): 1035-39.
28. Geissner E. The Pain Sensation Scale (SES) hand instruction, Gottinger, Hogrefe. 1996.
29. Geissner E. The Pain Perception Scale—a differentiated and change-sensitive scale for assessing chronic and acute pain. *Die Rehabil.* 1995; 34(4): 35-43.
30. Chibnall JT, et al. The Pain Disability Index: Factor structure and normative data. *Arch Phys Med Rehabil.* 1994; 75: 1082-86.
31. Dillmann U, et al. Assessment in Chronic Pain Patients. *Schmerz.* 1994; 100–110.
32. Beck AT, et al. Beck Depression Inventory–II. *APA Psyc Tests.* 1996.
33. Gallagher D, et al. Reliability of the Beck Depression Inventory with older adults. *J Consult Clin Psychol.* 1982; 50(1): 152–53.
34. Kuhner C, et al. Reliability and validity of the Revised Beck Depression Inventory (BDI-II). Results from German samples. *Neurologist.* 2007; 78(6): 651-56.
35. Sullivan MJL, et al. The Pain Catastrophizing Scale: Development and validation. *Psychol Assess.* 1995; 7: 524-32.
36. Meyer K, et al. Cross-cultural adaptation, reliability, and validity of the German version of the Pain Catastrophizing Scale. *J Psychosom Res.* 2008; 64(5): 469–78.
37. Kabat Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *Revision.* 1984; 7(1): 71–2.
38. Kabat Zinn J, et al. The clinical use of mindfulness meditation for the self-regulation of chronic pain. *J Behav Med.* 1985; 8:163–90.
39. Holzel BK, et al. Perspectives How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural. *Per Psychol Sci.* 2015; 6(6): 537–59.
40. Dehghani M, et al. Modification of attention biases in chronic pain patients: a preliminary study. *Eur J Pain* 2004; 6; 585-94.
41. Teasdale JD, et al. Metacognitive awareness and prevention of relapse in depression: Empirical evidence. *J Consult Clin Psychol.* 2002; 70(2), 275–87.
42. Gard G. Body awareness therapy for patients with fibromyalgia and chronic pain. *Disabil Rehabil.* 2005; 27(12):725-28.
43. Ribera D, et al. Interception, body awareness and chronic pain: results from a case-control study, *Int J Osteopat Med.* 2014; 1; 18:22-32.
44. Cioffi D, et al. Delayed Costs of Suppressed Pain. *J Pers Soc Psychol.* 1993; 64(2):274-82.
45. Koechlin H, et al. The role of emotion regulation in chronic pain: A systematic literature review. *J Psychosom Res.* 2018; 107:38-45.
46. Cracken LM, et al. A prospective study of acceptance of pain and patient functioning with chronic pain. *Pain.* 2005; 118:164-69.
47. Ruskin D, et al. “I learned to let go my pain” The effects of mindfulness meditation on adolescents with

- chronic pain: An Analysis of Participant's treatment experience. *Child*. 2017; 4:110.
48. Atkins P, et al. Mindfulness, identity and work: Mindfulness training creates a more flexible sense of self. 2015; 133-62.
 49. Olendzki A. The transformative impact of non-self.Buddhist thought and applied psychological research: Transcending the boundaries. 2006; 250–261.
 50. Xia T, et al. The Many Roads to Mindfulness: A Review of Non mindfulness-Based Interventions that Increase Mindfulness. *J Altern Complement Med*. 2019; 25 (9).
 51. Howell A, et al. Relations among mindfulness, well-being, and sleep. *Pers Individ Dif*. 2008; 45 (8): 773-77.