Mindfulness in Patients with Upper-Extremity Conditions: A Summary of Existing Literature

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Abstract

Mindfulness implies entering a mental state of awareness which allows for the reframing of an experience, and functionality has shown to be influenced by mindset. The aim of this systematic review was to assess effects of mindfulness in patients with upper-extremity conditions. PubMed, Embase, Cochrane, and CINAHL databases were searched on June 19, 2019, for studies investigating mindfulness in patients with upper-extremity conditions. Two validated instruments for methodologic assessment were used to assess study quality. Studies that reported pain, psychological, or functional outcome measures were included. One randomized controlled trials and three observational studies were included, which together included 335 patients that completed final follow-up. The weighted average age was 52.4 years and 48% of the patients were male. Evaluation of the outcome measures used was immediately after the mindfulness intervention or assessment in all studies. Mindfulness appeared to be positively associated with less pain (though below the minimal clinically important difference), increased mood, and better function. Mindfulness is associated with increased mood and possibly better functionality in adults with a large range of upper-extremity conditions when measured or used as an intervention. Future researcher should expand the subject as only four studies were included in this review. This is a Level IV study.

Keywords

- systematic review
- mindfulness
- upper extremity
- pain
- mood
- function

Introduction

Despite a relatively narrow range of severity in pathophysiology, functional outcomes for any given upper-extremity diagnosis can be highly variable.¹ This fluctuation can well be explained by the biopsychosocial model, which emphasizes that illness is a combination of disease, mindset, and circumstances.² As psychosocial factors are a notable determinant of interpatient symptom variability and subsequent disability, some patients will have to learn to live with permanent limitations by way of coping mechanisms or acceptance-based therapies.^{3–5} A leading example for acceptance-based therapies is mindfulness-based stress reduction (MBSR): a meditation program designed to integrate Buddhist meditation with

contemporary clinical practice.⁶ Engagement in mindfulness implies entering a mental state of awareness of thought and focus which allows for reframing of an experience. Apart from being a practice, mindfulness is also a way of being in the world and can be measured as such. It not only emphasizes the aspect of focusing on the present moment, but also targets the attitudes with which this attention is applied such as acceptance, patience, and openness.⁶ While the concept of mindfulness has historically been associated with spirituality rather than mainstream psychology, mindfulness research has gathered increased interest in the last decade. Utility has been shown for improving psychological, pain related, and possibly functional outcomes.^{7–10} Furthermore, acceptability of mindfulness in daily practice by patients

seems high, and a large share of patients continues with the meditation practice as a part of their daily lives after ending a mindfulness program.^{11,12} This implies applicability of mindfulness to patients' daily lives, which, in principle, makes it a viable treatment option for orthopedic patients.

In a technical field such as upper-extremity surgery, functionality has been shown to be influenced by mindset, and a pilot study has shown promising results in patients with upper-extremity conditions.^{11,13} A comprehensive review of the literature would offer additional insights on the clinical implications of mindfulness in patients with upper-extremity conditions, and to our knowledge such a study has not yet been conducted. Therefore, the aim of this systematic review was to assess the effects of mindfulness in patients with upper-extremity conditions, by including pain, psychological and functional outcome measures. We hypothesized that mindfulness improves pain, mood, and functionality in patients with upper-extremity conditions.

Materials and Methods

This systematic review and meta-analysis followed guidance published by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) and MOOSE (Meta-analysis Of Observational Studies in Epidemiology) to improve reporting quality.^{14,15} No ethical committee approval was necessary for this literature review, a published protocol for this review does not exist.

Search Strategy and Eligibility Criteria

Two reviewers (T.K., D.S.) independently conducted an electronic systematic search in MEDLINE, Embase, CENTRAL, and CINAHL databases on June 19, 2019. Studies published up until this date were included in this systematic review. Randomized controlled trials (RCTs) as well as prospective and retrospective observational studies investigating mindfulness in patients with upper-extremity conditions were included. Exclusion criteria were: (1) articles written in another language than English, German, French, or Dutch; (2) letters, comments, conference abstracts, case reports, study protocols, and reviews; (3) studies that did not report pain, psychological or functional outcome measures. After removal of duplicates, the identified studies were independently screened on title and abstract and assessed for eligibility by the two reviewers (T.K., D.S.). Disagreement was solved through discussion with a third independent reviewer (D.V.). After screening, potential suitable articles were independently assessed based on full text. Citation tracking and cross-reference screening were performed on included studies (T.K.). The search syntax is provided in ►**Supplementary Appendix A** (available in the online version).

Data Extraction

Data extraction was done independently by two reviewers (T.K., D.S.). The following baseline data were extracted: first author, year of publication, country in which the study was performed, study design, type of mindfulness application

used, type of upper-extremity conditions, number of patients, mean age, sex distribution, type of pain, mood and functional outcomes were reported. When possible, 95% confidence intervals and standard deviations (SD) were extracted. Ranges were only reported if the SD was not available. Any disagreements in the data extraction were solved through discussion.

Quality Assessment

Two reviewers (T.K., D.S.) independently used the Cochrane Risk of Bias Assessment Tool and the Methodological Index for Non-Randomized Studies (MINORS) tool to evaluate the methodological quality of the studies included. The Cochrane Risk of Bias Assessment Tool was designed to identify flaws in the study design, conduct, analysis and reporting of RCTs, though is also recommended for quality assessment of observational studies.^{16,17} The MINORS tool is a validated instrument designed to assess the methodological quality of RCTs and observational studies.¹⁸ In addition, it is applicable to both comparative and noncomparative studies. The MINORS score ranges from 0 to 24 in comparative studies and from 0 to 16 in noncomparative studies; a higher score represents better methodological quality. Disagreements between the two reviewers in the Cochrane Risk of Bias Assessment Tool and the MINORS score were solved through discussion.

Outcome Measures

The primary outcome measures were pain and mood as described by the studies included, such as pain intensity according to the numeric rating scale (NRS) and mood outcomes such as anger/depression/anxiety, respectively.¹⁹ Secondary outcome measures were patient reported functional outcomes such as disability of the arm, shoulder and hand (DASH) questionnaire or the patient rated wrist and hand evaluation.^{20,21}

Statistical Analysis

Descriptive statistics were used to display the means, standard deviations, and ranges for all outcome measures as described in the included studies. A *p*-value of <0.05 was considered statistically significant.

Results

Search Strategy and Quality Assessment

A total of four studies were included: one RCT and three prospective observational studies.^{11,22-24} The search results are summarized in the flowchart in ►**Fig. 1**. Results of the quality assessment using the Cochrane Risk of Bias Assessment Tool and the MINORS score per study are provided in ►**Supplementary Appendix B** (available in the online version). The amount of positive points on the Cochrane Risk of Bias Assessment Tool was 5 for the RCT, and 2 for the observational studies. The MINORS score for the RCT was 24, the MINORS score for all observational studies was 12. The MINORS criteria for unbiased assessment of study end points were only met in the RCT, as comparative studies have the

Fig. 1 Flowchart of search results.

potential to score positive on all domains in contrary to the noncomparative studies. Inclusion of consecutive patients was only mentioned in half of the studies.

Description of Studies

Publication dates of the studies span 2014 to 2018 (►Table 1). Two studies included all patients that had an appointment at the upper-extremity outpatient surgical

practice of a large regional teaching hospital. The other two studies included only patients with nontraumatic or non-acute upper-extremity conditions that presented to the same outpatient office. The four studies together included 335 patients that completed final follow-up, the weighted average age was 52.4 years and 48% of the patients were male. The mindfulness intervention or assessment was performed during a visit to an orthopedic hand surgeon,

Table 1 Baseline characteristics

First author and year of publication	Country	Design	Type of intervention	Type of upper-extremity illness	Patients	Mean age ($\pm$ SD)	Male/Female	Pain outcome	Mood outcome	Functional outcomes
<i>Single cohort studies</i>										
Beks et al 2018	United States	PC	Mindfulness questionnaire	Nontraumatic upper-extremity conditions	126	53 ($\pm$ 17)	71/55	Pain intensity (NRS)	NR	PROMIS upper extremity
Chad-Friedman et al 2017	United States	PC	Mindfulness-based video exercise	Any upper-extremity illness	20	47 ($\pm$ 16)	11/9	Pain intensity (NRS)	STAI-40, emotional thermometer (distress/anxiety/depression/anger)	NR
Voskuil and Ring 2014	United States	PC	Mindfulness questionnaire	Nonacute upper-extremity conditions	64	49 ($\pm$ 18)	18/46	Pain intensity (NRS)	NR	PROMIS upper extremity
<i>Comparative studies</i>										
Westenberg et al 2018	United States	RCT	Mindfulness-based video exercise	Any upper-extremity illness	63	55 ($\pm$ 15)	30/33	Pain intensity (NRS)	STAI-40, emotional thermometer (anxiety/depression/anger)	NR
			Time matched educational pamphlet (control)		62	54 ($\pm$ 15)	32/30			

Abbreviations: NR, not reported; NRS, numeric rating scale; PC, prospective cohort; PROMIS, patient reported outcomes measurement information system; SD, standard deviation; STAI, state trait anxiety index; RCT, randomized controlled trial.

evaluation of the outcome measures used was immediately after the mindfulness intervention or assessment in all studies.

Questionnaires Used

For the assessment of mindfulness, Beks et al and Voskuil and Ring used the short version of the Five Facet Mindfulness Questionnaire and the Philadelphia Mindfulness scale, respectively.^{22,23} Both questionnaires are self-reported and measure present time mindfulness. The Five Facet Mindfulness Questionnaire is a validated questionnaire consisting of 24 items about everyday experiences. Every statement is answered on a 1 to 5 Likert-type scale, ranging from 1 = never true to 5 = always true. Scores range from 4 to 25, with higher scores indicating more mindfulness.²⁵ The Philadelphia Mindfulness scale is a validated questionnaire that consists of two separate constructs (awareness and acceptance) that do not correlate and are intended for separate analysis.²⁶ In total, respondents answer 20 items also using a 1 to 5 Likert-type scale, ranging from 1 = never to 5 = always. Scores range from 10 to 50, with higher scores indicating more mindfulness.

All studies used the NRS as an outcome for pain intensity, a self-reported pain measure in which respondents are asked to verbally rate the pain they are experiencing on an 11-point scale that ranges from 0 (no pain) to 10 (severe pain).²⁷

Chad-Friedman et al and Westenberg et al reported mood as measured by the Emotion thermometer.^{11,24,28} This is a

validated, self-reported questionnaire that consists of five visual analogue scales that measure four emotional domains (distress, anxiety, depression, and anger). Each domain is rated from 0 (none) to 10 (extreme) and scores range from 0 to 40. Participants were asked to circle the number that best described their levels of distress over the past 7 days. Another outcome measure that was used to measure anxiety was the state-trait anxiety inventory, a validated self-reported questionnaire that contains two subscales to assess state (momentary) anxiety and trait (general) anxiety. It consists of 40 questions that are each answered on a 4-point Likert-type scale, higher scores are positively correlated with higher levels of anxiety.²⁹

Beks et al and Voskuil and Ring used the Patient Reported Outcomes Measurement Information System (PROMIS) Upper-Extremity and short version of the Disability of the Arm, Shoulder and Hand (QuickDASH), which are validated questionnaires to assess upper-extremity functionality.^{22,23,30,31} The PROMIS Upper-Extremity questionnaire assesses the extent to which the upper-extremity has been limited and evaluates physical activities that incorporate the use of the arms and hands. Lower scores indicate a higher level of disability. The QuickDASH is a standardized questionnaire that captures the patient's own assessment of upper extremity disability and ability to perform certain tasks out of which a score is computed, only higher scores indicate a higher level of disability.

Effects on Pain Intensity

Westenberg et al and Chad-Friedman et al both found significant decreases in pain intensity after a mindfulness-based video exercise, however both changes were below the reported minimal clinically significant

difference (►Table 2).^{11,24,27} Beks et al found that mindfulness was associated with decreased pain intensity in bivariate analysis.²² Voskuil and Ring found no association between mindfulness and decreased pain intensity.²³

Table 2 Results

First author and year of publication	Type of intervention	Design	Patients	Mean NRS score	p-Value	Mean score (before SD; after SD; mean difference SD)		p-Value	Mean PROMIS upper extremity score	p-Value
Single cohort studies										
Beks et al, 2018	Mindfulness questionnaire	PC	126	3.0 ± 2.6; patients with high total FFMQ score: 0.19	0.029	NR			58 ± 7.7; patients with high nonre-active-FFMQ score: +0.18	0.045
Chad-Friedman et al, 2017	Mindfulness-based video exercise	PC	20	Before intervention: 3.30 ± 2.56; after intervention: 2.55 ± 2.31; mean difference: 0.75 (0.35–1.15)	0.001	STAI: 36.55 ± 10.83; 28.60 ± 7.65; 7.95 ± 9.54		0.001	NR	
						Distress: 3.20 ± 2.04; 1.65 ± 1.73; 1.35 ± 1.50		0.001		
						Anxiety: 3.80 ± 2.28; 1.65 ± 1.73; 2.15 ± 1.42		<0.001		
						Depression: 2.25 ± 2.65; 0.85 ± 1.53; 1.40 ± 1.70		0.002		
						Anger: 2.10 ± 2.17; 0.65 ± 0.93; 1.45 ± 1.67		0.001		
Voskuil and Ring, 2014	Philadelphia mindfulness scale	PC	64	High awareness score: +0.20	NS	NR			High awareness score: +0.27	0.032
Comparative studies										
Westenberg et al, 2018	Mindfulness-based video exercise	RCT	63	Intervention group: 3.03 ± 0.12; control group: 3.49 ± 0.12; mean difference: 0.46 (0.12–0.80)	0.008	STAI EP: 35.06 ± 14.14; 32.35 ± 0.59	2.94 (1.29–4.59)	0.001	NR	
STAI MBVE: 34.13 ± 12.41; 35.29 ± 0.59										
Anxiety EP: 2.53 ± 2.88; 1.49 ± 0.19	0.61 (0.08–1.14)		0.024							
Anxiety MBVE: 2.89 ± 2.95; 2.10 ± 0.19										
Depression EP: 1.76 ± 2.79; 1.03 ± 0.10	0.44 (0.15–0.73)		0.004							
Depression MBVE: 1.25 ± 2.21; 1.47 ± 0.11										
Anger EP: 1.47 ± 2.54; 0.76 ± 0.12	0.60 (0.26–0.94)		0.001							
Anger MBVE: 1.48 ± 2.66; 1.36 ± 0.12										
	Time-matched educational pamphlet (control)	62								

Abbreviations: EP, educational pamphlet; FFMQ, five facet mindfulness questionnaire; MBVE, mindfulness-based video exercise; NRS, numeric rating scale; PROMIS, patient reported outcomes measurement information system; PC, prospective cohort; NR, not reported; SD, standard deviation; STAI, state trait anxiety inventory; RCT, randomized controlled trial.

Effects on Mood

Chad-Friedman et al and Westenberg et al both found significant decrease in depression and anger scores after the mindfulness-based video intervention used.^{11,24} Anxiety was measured with two outcome measures in both studies, in which both showed significant decrease in anxiety after the intervention. Additionally, Chad-Friedman et al found decreased distress scores with higher mindfulness.

Effects on Functional Outcome

Beks et al and Voskuil and Ring studied upper-extremity function in association with mindfulness. Beks et al found that the mindfulness skill of being nonreactive to fluctuations of the mind was associated with higher upper-extremity physical function in bivariate analysis, though this association was not present in multivariate analysis.²² Additionally, they found no such association for the total Five Facet Mindfulness Questionnaire score. Voskuil and Ring did find a positive association between awareness of internal and external stimuli and less functional disability.²³

Discussion

Human illness behavior and experience is best described by the biopsychosocial model.² Furthermore, the evidence is clear that the experience of pain and disability in patients who underwent surgery relies heavily on mindset and coping strategies.³⁻⁵ An ill-functioning arm can have an enormous impact on a person's daily life, and despite a relatively narrow range of severity in pathophysiology, interpatient symptom intensity varies widely.¹ This raises the question to what extent other factors such as psychological status influence outcome in patients with upper-extremity conditions. In this systematic review, mindfulness appeared to have a positive effect on pain, mood, and possibly function in patients with upper-extremity conditions. The recent publications on this subject also indicate the actuality of mindfulness in present day, and to our knowledge, a systematic review that studied mindfulness in relation to patients with an upper-extremity condition had not yet been conducted.

While there are no previous systematic reviews or meta-analyses that studied mindfulness in relation to the upper-extremity, several systematic reviews and meta-analyses on this subject have been conducted on more general patient populations. Anheyer et al reviewed MBSR in patients with low back pain and included seven RCTs with a total of 864 patients.³² They found potential short-term improvement in pain intensity and functionality with MBSR compared with usual care, however, these differences were not clinically significant nor sustained in the long term. Comparisons of MBSR to other interventions such as cognitive behavioral therapy (CBT) or a health education program showed no improvement in pain, functionality, mental health, or even mindfulness.³³ It should be noted though, that studies that studied yoga were included in these reviews too which could have improved low back pain symptoms with physical activity alone.³⁴ Veehof et al included 10 controlled and 12 non-controlled studies that assessed 1,235 patients and studied

the effects of MBSR compared with other acceptance-based interventions on mental and physical health in chronic pain patients. Small to medium effect sizes were found for pain intensity, depression, anxiety, physical wellbeing, and additionally, quality of life. The authors furthermore concluded that acceptance-based therapies such as MBSR are comparable to CBT, though no conclusions could be made on MBSR versus regular supportive care of other passive controlled groups. Hilton et al included 38 studies which assessed 3,536 subjects and studied the effects of MBSR on patients with chronic pain conditions.⁹ Thirty of the studies were RCTs and compared MBSR to regular treatment, passive controls, and education or support groups. They found that mindfulness meditation had a positive effect on chronic pain and depression scores. All in all, the authors of these reviews on more general patient populations have somewhat mixed judgments, though generally tend to conclude that mindfulness is beneficial for pain, mood, and functionality.

Our findings should be considered in light of a few limitations. First, the results of this review might be influenced by missed studies in the database search and by publication bias. However, the search we performed was extensive and the studies that were included were screened for citations and references. Due to the small number of studies included, we were not able to perform a funnel plot. Second, only two of the studies studied a mindfulness intervention, of which one was a pilot study with a small sample size without control group. The other two studies studied association with mindfulness rather than mindfulness as an intervention. In addition, the intervention studies studied the immediate effect of mindfulness. This makes it difficult to draw conclusions about the durability of the desired effect, though promising and long lasting results have been demonstrated in different patient populations.^{35,36} It should also be noted that the studies by Voskuil and Ring and Beks et al did not describe any adjustment of statistical inference in their bivariate analysis of multiple comparisons. Third, it should be noted that all studies included were performed in the same outpatient office by the same research group, which potentially is a source for shared bias. Furthermore, generalizability is limited as the outpatient office is located in a major academic hospital that serves mostly white patients. The results of these studies may not apply to other patient populations, as pain perception (for e.g.) has been demonstrated to differ culturally.³⁷ Additionally, the studies included a variety of upper extremity diagnoses; this may also limit the conclusions that may be drawn from this review. Lastly, we know of no adverse physical effects of mindfulness, though psychological adverse effects might exist. To our knowledge, this has not been previously studied and we see this as an area for future research.

Future research should also address the association between mindfulness as an intervention and upper-extremity function while minimal clinically significant differences should be established for the relevant outcome measures that report mood and upper-extremity functionality. Furthermore, as 8-week mindfulness programs have shown significant improvement in pain that was maintained

at 3-month follow-up, we hypothesize what the long-term effects of mindfulness are in relation to the upper-extremity in terms of mood and functionality.^{38,39} The current included studies merely studied the immediate effect of mindfulness in contrast to the long-term.^{11,22-24} Furthermore, yoga and meditation were not studied in this review. It is possible both treatments have merits for upper-extremity patients, as both treatments are on the spectrum of acceptance-based therapies and yoga offers an additional physical stimulus. We see these treatments as areas for future research in relation to upper-extremity patients.

Research on the subject has proliferated in the last decade, not in the least in patient populations with upper-extremity conditions.^{11,22-24} The recent literature shows evidence that a short mindfulness intervention can cause improvement in mood in adults with a large range of upper-extremity conditions. It also shows that there is possible evidence to support an association between mindfulness and increased upper-extremity function. Mindfulness seems acceptable to patients in the daily practice and a large share of patients continues with the meditation practice as part of their daily lives after ending a mindfulness program.^{11,12} Readers should be aware, however, that despite a recent spike in publications concerning mindfulness, we only found four studies related to upper-extremity injuries which limit the accuracy of our conclusions. Future researchers should look into expanding the subject as first results are promising.

Ethical Approval

As no humans or animals were studied in this systematic review, ethical committee approval by the institutional review board was not necessary.

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Conflict of Interest

None declared.

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