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The influence of mindfulness on upper extremity illness

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Abstract
Background Previous studies suggest a benefit of mindfulness-based interventions on pain conditions. This study addresses the null hypothesis that mindfulness is not correlated with pain intensity or magnitude of disability in orthopedic upper extremity conditions.
Methods In a prospective cohort, the correlation of the two separate aspects of mindfulness—acceptance and awareness—with disability and pain intensity was tested in patients with nonacute upper extremity conditions. Regression analyses were performed to determine factors associated with arm-specific disability and pain intensity.
Results Awareness and acceptance both correlated with arm-specific disability, but only awareness was retained as a predictor in the best multivariable model. Neither awareness nor acceptance correlated with pain intensity. Pain interference and symptoms of depression accounted for more of the variation in disability and pain intensity.
Conclusion Improved mood and decreased pain interference (a greater sense that one can accomplish one's goals in spite of pain) may be more fruitful than increased mindfulness for patients with nonacute conditions of the upper extremity.

Keywords Mindfulness · Pain interference · Upper extremity illness

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Introduction

Mindfulness is the observation of external and internal stimuli—such as physical symptoms, emotions, or thoughts—in a nonjudgmental and dispassionate way [7, 19]. When we are learning to ride a bicycle, for instance, we must be very mindful of our position on the seat and the pedals, our grip and control of the handlebars, our balance, the force we apply to the peddles, how to work the brakes, etc. Those that know how to ride a bicycle do not even think about it—they just get on and ride. Their body mindlessly knows what to do.

A person that begins to notice pain in the base of their thumb from arthritis might stop what they are doing, wonder what is wrong with their thumb, and have the sense that they may not be able to rely on the thumb in the future unless they do something about it. The human safety system mindlessly engages. We protect and prepare for the worst. In contrast, a person that is mindful of both their diagnosis and the normal human response to pain will be aware of their programmed thoughts, behaviors, and emotions in response to pain; will appreciate that things are often not as bad as they seem; and will be patient and reserve judgment [19]. Previous studies on experimental pain stimuli and studies analyzing patients with general chronic pain or chronic back pain suggest that greater mindfulness correlates with lower pain intensity and magnitude of disability [7, 18–21, 30].

There are several validated questionnaires that measure mindfulness [4, 6, 22]. The Philadelphia Mindfulness Scale addresses both basic constructs of mindfulness: awareness and acceptance [6]. Awareness is the continuous monitoring of ongoing internal and external stimuli, and acceptance is the nonjudgmental stance towards one's experience [5].

This study addresses the null hypothesis that acceptance and awareness do not correlate with arm-specific disability or pain intensity in patients with a nonacute upper extremity condition.

Material and methods

Under IRB approval, 64 patients who met the inclusion criteria for this study were prospectively enrolled during a visit to an orthopedic hand surgeon. Inclusion criteria were (1) aged 18 years or older, (2) nonpregnant, and (3) nonacute upper extremity condition (e.g., no fractures, sprains, dislocations, lacerations, or infections). Verbal informed consent was obtained before enrolment.

The following demographic and clinical factors were recorded: age, sex, marital status, employment status, smoking habit, diagnosis, affected side, dominant side, duration of complaints, and presence of other pain conditions (Table 1). Pain intensity was measured on an 11-point ordinal scale (Numerical Rating Scale). Mindfulness was measured with the Philadelphia Mindfulness Scale (PHLMS), which consists of two separate constructs—awareness and acceptance—that do not correlate and are intended for separate analysis [6]. Upper extremity-specific disability was measured using the brief version of the Disabilities of Arm, Shoulder and Hand Questionnaire (QuickDASH). Other important psychological aspects of human illness behavior were measured with the Patient Reported Outcomes Measurement Information System (PROMIS) pain interference, PROMIS depression, and the five-item Short Health Anxiety Inventory (SHAI-5) [27].

Table 1 Demographics

	Number	Percentage
Sex		
Men	18	28
Women	46	72
Age		
Mean (years) ± SD	49±18	
Range	19–90	
Marital status		
Single	21	33
Living with partner	5	7.8
Married	30	47
Separated/divorced	2	3.1
Widowed	6	9.4
Diagnosis		
Trigger finger	8	13
Carpal tunnel syndrome	14	22
Ganglion	11	17
Tendinopathy	10	16
Arthritis	5	7.8
Posttraumatic	6	9.4
Nonspecific	10	16
Dominant hand affected		
Yes	43	67
No	21	33
Duration of symptoms		
Mean (months) ± SD	24±46	
Range	1–240	
Other pain conditions		
None	41	64
Upper extremity—same side	3	4.7
Upper extremity—other side	3	4.7
Nonupper extremity	17	27
Smoke		
Yes	12	19
No	52	81

Statistical analysis

Power analysis determined that 64 patients provide 80 % power to detect a small correlation ($r=0.30$) at the 0.05 significance level. Since the majority of continuous data in this study did not have a normal distribution, nonparametric tests were used. Spearman's rho was calculated for the correlation between two continuous variables, and the Mann–Whitney U test was used to compare means between two categorical variables. All variables with $p<0.08$ in bivariable analysis were entered into backward stepwise linear regression analyses to determine predictors of arm-specific disability and pain intensity.

Results

Arm-specific disability

In bivariable analyses, greater awareness and lower acceptance correlated with greater arm-specific disability. Pain interference, depression, and health anxiety also correlated with disability (Table 2). The best linear regression model for greater disability included higher score on the awareness

Table 2 Bivariable analysis

	Disability[a]		Pain intensity[b]	
	ρ	P value	ρ	P value
Awareness	0.27	0.032	0.20	ns
Acceptance	−0.24	0.055	−0.16	ns
Pain interference	0.84	<0.001	0.39	0.0013
Depression	0.53	<0.001	0.42	<0.001
Health anxiety	0.23	0.062	0.087	ns
Age	0.035	ns	0.15	ns
Duration of complaints	0.040	ns	0.16	ns

ns non significant

[a] As measured by the QuickDASH

[b] As measured on an 11-point numerical rating scale

subscale, greater pain interference, greater symptoms of depression, and diagnosis other than trigger finger, accounting for 78 % of the variance in disability. Pain interference and symptoms of depression accounted for most of the variation in disability (Table 3).

Pain intensity

In bivariable analysis, there was no correlation between pain intensity and either subscale of mindfulness (Table 2). The best multivariable linear regression model of greater pain intensity included male sex, greater pain interference, and more symptoms of depression, accounting for 30 % of the variance (Table 3).

Discussion

In this study of patients with nontraumatic upper extremity conditions, greater awareness correlated with greater arm-specific disability but not with greater pain intensity. Greater acceptance correlated with lower disability, but was not retained in the best multivariable model. Pain interference and symptoms of depression accounted for magnitude of disability and pain intensity better than mindfulness. In other words, consistent with prior work, the lower one's mood and the greater one's tendency to feel hopeless in response to pain, the greater the pain one experiences and the less one can do, independent of either awareness of or acceptance of the symptoms [1, 10, 12, 14, 16, 26].

Table 3 Multivariable analysis ($n=64$)

	Significance	Odds ratio	Partial R-squared	Adjusted R-squared
Predictors of disability[a]				0.78
Pain interference[b]	<0.001	5.2	0.66	
Awareness	<0.05	1.5	0.088	
Depression[c]	<0.01	1.4	0.13	
Marital status: separated or divorced	<0.05	1.4	0.072	
Diagnosis: trigger finger	<0.05	0.69	0.11	
Predictors of pain intensity[d]				0.30
Pain interference[b]	<0.05	2.0	0.099	
Depression[c]	<0.05	1.9	0.089	
Sex: female	<0.05	0.57	0.078	

Variables entered into regression: (1) Disability: awareness, acceptance, pain interference, depression, health anxiety, marital status: separated/divorced, smoking habit, diagnosis: trigger finger, diagnosis: arthritis. (2) Pain intensity: pain interference, depression, sex, smoking habit

[a] As measured by the QuickDASH

[b] As measured by the Patient Reported Outcomes Measurement Information System—pain interference

[c] As measured by the Patient Reported Outcomes Measurement Information System—depression

[d] As measured on an 11-point numerical rating scale

The outcomes of our study should be interpreted with some reservations. Our data are from a single center and may not be generalizable. Furthermore, power analysis was done for our primary null hypothesis, and secondary analyses may be underpowered. Finally, this was an observational study on nonacute upper extremity conditions and all comments on potential interventions are speculative and based on analogies with data from studies on other conditions.

The findings of our study might be influenced by the mindfulness measure we used. For instance, prior studies using a measure that does not separate awareness and acceptance (the Mindful Attention Awareness Scale [MAAS] [4]) found that greater mindfulness was associated with less disability, anxiety, depression, and catastrophic thinking in patients with general chronic pain or chronic back pain [7, 19]. Mindfulness-based approaches can be effective in chronic low back pain, rheumatoid and osteoarthritis, tension headache, and pain following surgical procedures, and they can ameliorate pain during invasive medical procedures, although the magnitude of the effect varies [2, 11, 15].

On the other hand, excessively negative or hopeless thoughts in response to pain (greater pain interference or catastrophic thinking, and lower self-efficacy) seem to be more important than awareness and seem to go beyond mere acceptance. In fact, high self-efficacy (confidence that one can achieve one's goals in spite of pain) might represent mindless adaptation. In other words, it is possible that the goal is practiced acceptance and adaptation rather than mindful filtering of potentially unsettling symptoms.

There is evidence that patients with high pain-related anxiety and patients with chronic musculoskeletal pain selectively orient their attention toward painful stimuli, reflecting difficulty disengaging from painful stimuli rather than hypervigilance [3, 9, 28]. Among patients with chronic back pain, greater awareness of symptoms seems to increase disability in the presence of catastrophic thinking [7, 13]. Experimental settings in which mindful attention (awareness) and guided imagery (directing attention away) were compared demonstrated no difference in their impact on pain intensity in children [23, 24]. In patients with chronic back pain, neither strategy reduced pain intensity, but distraction increased the ability to carry out specific exercises [13, 17, 18].

On the other hand, in patients with chronic headache, mindfulness-based cognitive therapy significantly improved pain acceptance, self-efficacy, catastrophic thinking, and pain interference, but not pain intensity, compared to usual treatment [8]. It may be that this initial practice of mindfulness achieved a mindless self-efficacy.

Based on these findings and the results of the current study, lowering the attention paid to the pain (i.e., awareness) may not be as helpful as building automatic or mindless habit of remaining confident that they can continue with activities in spite of pain (i.e., that they can depend on their body despite the pain). A systematic review of randomized controlled trials analyzing patients with chronic pain found that cognitive behavioral therapy (recognizing maladaptive thoughts and behaviors and practicing new more adaptive replacements) has small to moderate effects on pain, disability, and catastrophic thinking compared to usual treatment immediately after treatment, with some effects maintained at 6 months [32].

In conclusion, for patients with upper extremity illness, we found that greater awareness leads to greater disability, perhaps mediated by greater pain interference (catastrophic thinking) and symptoms of depression. Therefore, we cannot recommend increasing mindfulness—at least as measured with the PHLMS—without additional research to support it as an important and useful construct in the upper extremity. Therapies that can reduce symptoms of depression and increase self-efficacy may be better targets for reducing pain and disability.

Conflict of Interest Timothy Voskuijl and David Ring have no conflict of interest related to the content of this study.

Statement of Human and Animal Rights This study was approved by the Human Research Committee at our institution. Verbal informed consent was obtained from all patients for being included in the study.

Statement of Informed Consent Informed consent was obtained from each patient.

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