



Feasibility and Acceptability of a Group Mindfulness Intervention in a Difficult Asthma Clinic

Ben Ainsworth^{1,2} · Aarti Patel³ · Caroline Eyles⁴ · Gail Elaine Davies⁴ · Ramesh Kurukulaaratchy² · Mike Thomas^{2,4}

Published online: 15 May 2020

© The Author(s) 2020

Abstract

Objectives Psychological dysfunction (such as anxiety) is common in people with difficult asthma and is associated with poor outcomes. Asthma guidelines increasingly emphasise the need to recognise and address co-morbidities, and it is plausible that appropriately targeted psychological interventions may be clinically and cost-effective. We hypothesised that mindfulness—facilitating adaptive responses to mental and emotional stress—would be acceptable and feasible for people with difficult asthma and undertook a pilot uncontrolled observational study.

Methods We offered a 4-week mindfulness intervention (four group sessions with 10–20 min of daily home practice) to adult patients attending difficult asthma clinics. Seventeen patients provided informed consent. Before and 3 months after the intervention, self-report questionnaires assessed asthma control, asthma-related quality of life, anxiety, depression, medication adherence and dysfunctional breathing symptoms. We conducted a focus group and follow-up telephone interviews with patients and collected routine clinic data including lung function.

Results Three-month follow-up patients had lower self-reported anxiety scores, but there were no significant changes in other self-report measures including asthma control and asthma quality of life—though numerical trends generally indicated improvement. Intervention adherence and study retention varied. Thematic analysis exploring qualitative data found overarching themes highlighting the acceptability of mindfulness treatments, and identified some practical challenges to attending the course.

Conclusions Patients consenting to the mindfulness intervention found it acceptable. Self-report measures suggest potential for positive impact on their wellbeing. Patients successfully integrated mindfulness with their existing treatment, although practical barriers prevented some from attending the face-to-face group course.

Keywords Asthma · Feasibility · Mindfulness · Quality of life · Anxiety

Asthma affects over 330 million people globally, imposing significant burdens for patients and carers, as well as a

substantial economic burden (Global Asthma Network 2018). The symptoms of asthma are distressing, with recurrent episodes of wheezing, chest tightness and breathlessness associated with episodes of bronchoconstriction. Breathlessness is a primary symptom of asthma, and is a primitive sensation comparable to pain, with a strong affective component, causing distress and anxiety (Spinoven et al. 1997). Patients with difficult and poorly controlled asthma have many more symptoms when compared to those with milder or better controlled disease; difficult asthma is associated with greater anxiety, impaired cognition and impaired coping mechanisms (Lavoie et al. 2010). Anxiety is the strongest independent predictor of the ‘unpleasantness’ of breathlessness (Spinoven et al. 1997), affecting health status and quality of life (QoL) more than lung function (Moy et al. 1998). Those with significant psychological morbidity additionally have poor asthma outcomes (including symptom burden,

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s12671-020-01391-w>) contains supplementary material, which is available to authorized users.

✉ Ben Ainsworth
b.ainsworth@bath.ac.uk

- ¹ Department of Psychology, University of Bath, Bath, UK
- ² National Institute for Health (NIHR) Southampton Biomedical Research Centre, University Hospitals Southampton NHS Foundation Trust, Southampton, UK
- ³ School of Psychology, Faculty of Social, Human and Mathematical Sciences, University of Southampton, Southampton, UK
- ⁴ Primary Care and Population Sciences, Faculty of Medicine, University of Southampton, Southampton, UK

mortality, hospitalisation and quality of life impairment in comparison with those without (Lavoie et al. 2006).

Pharmacological interventions are highly effective for treating asthma, yet even with the ability of modern treatment, less than half achieve good symptom control (Demoly et al. 2010). The reasons for poorly controlled asthma are complex but may include excessive anxiety (Rimington et al. 2001). Anxiety is associated with impaired self-management (Bender 2006) and psychological distress is up to six times more common in difficult asthma than in the general population (Thomas et al. 2011). Psychological factors significantly increased the burden of living with asthma (Stanescu et al. 2019) and are associated with increased hospitalisation (Wainwright et al. 2007) and increased mortality (Barton et al. 2005). Psychological co-morbidity is often unrecognised, and research to identify and treat such co-morbidity has been prioritised in recent calls (Edwards et al. 2017). Purported mechanisms include maladaptive behaviours such as hyperventilation or poor medication adherence and cognitive/affective factors such as poor symptom perception (Yii and Koh 2013). Systematic reviews assessing the effectiveness of non-pharmacological interventions for people with asthma report some improvements to quality of life and psychological outcomes (Yorke et al. 2015; Yorke et al. 2007). One treatment that may provide benefit for patients with difficult asthma is mindfulness, an intervention focused on awareness of bodily sensations and emotions in a calm and accepting way, frequently giving particular attention to breathing patterns (Kabat-Zinn 1990).

Mindfulness practice involves purposeful, non-judgemental attention to and acceptance of experiences, aiming to reduce anxiety, distress and depression (Shapiro et al. 2006). People with asthma often demonstrate maladaptive illness cognitions such as inaccurate symptom perception, which contribute to worse asthma outcomes (Janssens et al. 2012). Therefore, it is theorised that mindfulness may potentially modulate dysfunctional anxiety contributing to difficult asthma through improving dysfunctional cognitive-affective mechanisms (Janssens et al. 2009). A recent systematic review of mindfulness-based stress reduction demonstrated small to moderate effect size improvements to physical symptoms across a range of physical health conditions including asthma (Crowe et al. 2016) although further research was required. Pertinently, a randomised control trial (RCT) of mindfulness-based stress reduction led to improved quality of life and less perceived stress across 42 patients with mild, moderate and severe asthma (vs. 41 patients in a psychoeducation control intervention; Pbert et al. 2012). Furthermore, a qualitative study of patients with asthma and depression who undertook mindfulness-based cognitive therapy (MBCT) showed benefits for patients with respiratory disease including greater acceptance of symptoms and improved awareness of bodily sensation (Malpass et al. 2015).

One challenge to designing, implementing and evaluating mindfulness interventions is the considerable heterogeneity of

existing ‘mindfulness-based’ interventions. Mindfulness-based stress reduction (MBSR) was the original model developed by Kabat-Zinn to teach people self-management techniques to improve stress and anxiety (Shapiro et al. 2006). Mindfulness-based cognitive therapy (MBCT) is of a similar 8-week program that is informed by psychological models of depression (Teasdale et al. 2000). Attrition rates of MBSR/MBCT are often high due to time constraints, and short adapted courses have been shown to be effective delivered over a 4-week period or less, and it is possible that ‘abridged’ mindfulness courses may be increasingly cost-effective treatment strategies for clinical populations (Carmody and Baer 2009).

In line with guidelines by Bowen et al. (2009), we looked to conduct a focused feasibility study that explored the acceptability of a mindfulness intervention to people with difficult asthma. We hypothesised that a short-course (4 weekly 1.5-h sessions plus practice) mindfulness intervention that uses elements of MBSR (relevant to anxiety-related/‘attack’ aspects of disease) and MBCT (relevant to low mood and depression that often accompanies chronic illness) would be acceptable and would improve asthma-related quality of life and asthma control. We aimed to deliver and evaluate the intervention in patients with difficult asthma attending a hospital-based difficult asthma service.

The primary aim of the study was to determine whether a mindfulness intervention is acceptable and feasible to deliver for patients with difficult asthma. Study objectives were to (i) evaluate feasibility through measures of adherence and recruitment to study protocol, (ii) compare and evaluate the relevance of baseline and 3-month follow-up clinical and self-report questionnaire measures of asthma-specific quality of life, anxiety and asthma control, and (iii) to examine patient-perceived impact of the intervention on asthma control and general wellbeing, and assess barriers and facilitators to the intervention.

Methods

Participants

The WATCH Study is an ongoing ‘real-life’ observational study of patients in the University Hospital Southampton (UHS) Difficult Asthma Service (Azim et al. 2019). Patients are given the opportunity to enrol on the study during their clinical care, completing a range of measures during clinic visits that provide a parent database from which ‘satellite’ studies can recruit patients. At the time of recruitment, there were 275 people with asthma enrolled in the WATCH Study.

Study inclusion criteria: Over 18 years old, confirmed asthma diagnosis, enrolled in the Wessex AsThma CoHort of difficult asthma (WATCH Study) in Southampton (UK), score of 6 or greater for anxiety on the Hospital Anxiety and

Depression Scale (HADS; Zigmond and Snaith 1983; an initial eligibility cut-off of 8 was amended to 6 during the participant identification and recruitment phase to increase the number of eligible patients within the WATCH study).

Study exclusion criteria: previous diagnosis of major or unstable comorbid psychological disorders, other than anxiety or depression, currently participating in another asthma interventional study, acute exacerbation of asthma requiring a course of oral steroids within previous 28 days.

Seventeen participants (82% female) met inclusion criteria and provided informed consent. Baseline characteristics of participants who completed follow-up measures ('completers') and participants who did not ('non-completers') are reported in Table 1.

Routine clinic data were also collected at baseline. Eight participants reported food allergies, 9 participants reported drug allergies and 9 participants reported previous diagnosis of allergic rhinitis.

Baseline characteristics were similar across all measures with overall scores for the WATCH study (see Supplementary Material File 1).

Procedure

The study was an uncontrolled, prospective observational feasibility study with all participants offered the intervention. Self-report measures were taken during routine clinic appointments at baseline and 3-month follow-up, alongside routine clinic data that were collected at baseline. A focus-group was conducted at 6-week follow-up and follow-up phone calls were conducted at 3-month follow-up for participants who did not attend the focus group. The trial is reported according to the CONSORT extension for randomised pilot and feasibility trials (Eldridge et al. 2016).

Ninety potentially eligible participants identified in the WATCH Study database were contacted via letter, in which they were informed of the study and asked to attend a baseline appointment at Southampton General Hospital (see Fig. 1). Patients who did not respond to the letter were contacted by phone. After informed consent was obtained, baseline assessment was performed and participants were invited to attend one of two mindfulness group interventions. Six weeks after the interventions were completed, participants who had

Table 1 Baseline patient characteristics

Measure	Baseline <i>M</i> (SD)		
	Full baseline sample (<i>N</i> = 17)	Non-completers (<i>N</i> = 6)	Completers (<i>N</i> = 11)
Age	46.3 (12.7)	41.2 (11.3)	49.2 (13.0)
BMI	35.8 (8.93)	28.5 (6.81)	39.7 (7.50)
Oral steroid courses (last year)	4.73 (3.75)	4.00 (4.58)	5.10 (3.50)
Hospitalisations (last year)	1.41 (2.72)	1.83 (2.32)	1.18 (2.99)
GP visits (last year)	7.41 (7.00)	6.67 (5.82)	7.82 (7.81)
Asthma control	2.69 (1.36)	2.54 (1.71)	2.78 (1.21)
Quality of Life	4.07 (1.13)	3.93 (0.83)	4.14 (1.29)
Anxiety	9.18 (2.90)	10.0 (2.82)	8.73 (2.97)
Depression	6.94 (4.98)	7.00 (5.73)	6.91 (4.83)
State anxiety	46.6 (4.75)	45.8 (5.24)	48.0 (3.79)
Trait anxiety	47.6 (6.35)	45.0 (5.88)	52.5 (4.04)
Nijmegen	25.5 (12.3)	26.0 (13.6)	25.2 (12.2)
Mindfulness	4.39 (1.04)	4.22 (1.05)	4.50 (1.07)
Medication adherence	4.18 (0.58)	3.97 (0.82)	4.30 (0.39)
FEV ₁	2.12 (0.77)	2.32 (1.13)	2.03 (0.58)
FEV ₁ -predicted %	72.1 (19.8)	68.8 (21.6)	73.7 (19.8)
FEV ₁ /FVC %	68.0 (13.6)	59.4 (9.93)	72.3 (13.6)

Asthma control measured with ACQ (lower scores equate to better control); quality of life measures with AQLQ (higher scores equate to greater impairment); anxiety and depression measured with HADS (higher scores equate to more anxiety); state and trait anxiety were measured with STAI (higher scores equate to more state/trait anxiety). Breathlessness symptoms measured with Nijmegen (higher scores equate to more breathlessness); mindfulness measured with MAAS (lower scores equate to less mind-wandering); medication adherence measured with MARS-A (higher scores equate to better adherence); attention control measured with ACS (higher scores equate to better attention control). Lung function (FEV₁, FVC) measured with spirometry

attended at least one mindfulness session were asked to attend a focus group to discuss their experiences of mindfulness. They were then asked to attend a follow-up appointment approximately 3 months after their baseline appointment. As only 3 participants attended the focus group, all other participants were asked to participate in a semi-structured phone interview, with 9 consenting to this.

The focus group was conducted by a senior research fellow within the research team (CE), who had extensive experience in qualitative methodology and specific experience in research in mindfulness for cancer. The focus group discussion lasted 90 min and took place in a local, accessible hotel. Interview schedule included open questions, with prompts to encourage participants to provide in-depth responses and discussion amongst participants. The semi-structured phone interviews were conducted by a clinical psychologist (AP) with substantial experience in qualitative interviewing who used the same interview schedule in order to maintain consistency, using an open-conversation approach.

The focus group and interview schedule explored patient experiences of psychological and mindfulness interventions generally and of the specific mindfulness course that was offered for patients with difficult asthma. The focus group and interviews were digitally audio-recorded and then transcribed in readiness for analysis. The full interview schedule is available in Supplementary Material File 2.

Mindfulness Intervention

The mindfulness intervention was a reduced mindfulness course comprising of a 4-week intervention, utilising elements of both MBSR and MBCT that were appropriate for the needs

of the population. Each session lasted one and half hours, with 10–20-min recommended home practice a day. Each week covered a different topic area including training the mind to pay attention, reconnecting the mind and body, becoming aware that thoughts are not facts, and establishing on going practice (for more details see Table 2). The first session explicitly addressed patients' asthma symptoms, discussing how patients would feel about focusing on their breath to mitigate potential barriers to practice. In subsequent sessions, some content tailored specifically for difficult asthma (such as focusing on the sensations of the abdomen rather than the breath) and it was mentioned by participants in reflective discussion. Full detail of the mindfulness practice (including adaptations for people with difficult asthma) is included in Supplementary Material File 3.

The 4-week course was a run by an independent, qualified MCBT and MBSR practitioner, practicing yoga for 38 years, and mindfulness meditation for over 6 years, with experience running mindfulness groups in a wide range of settings including public, private and research arenas. The course took place in an easily accessible meeting room in a local hotel, approximately 4 miles from the hospital.

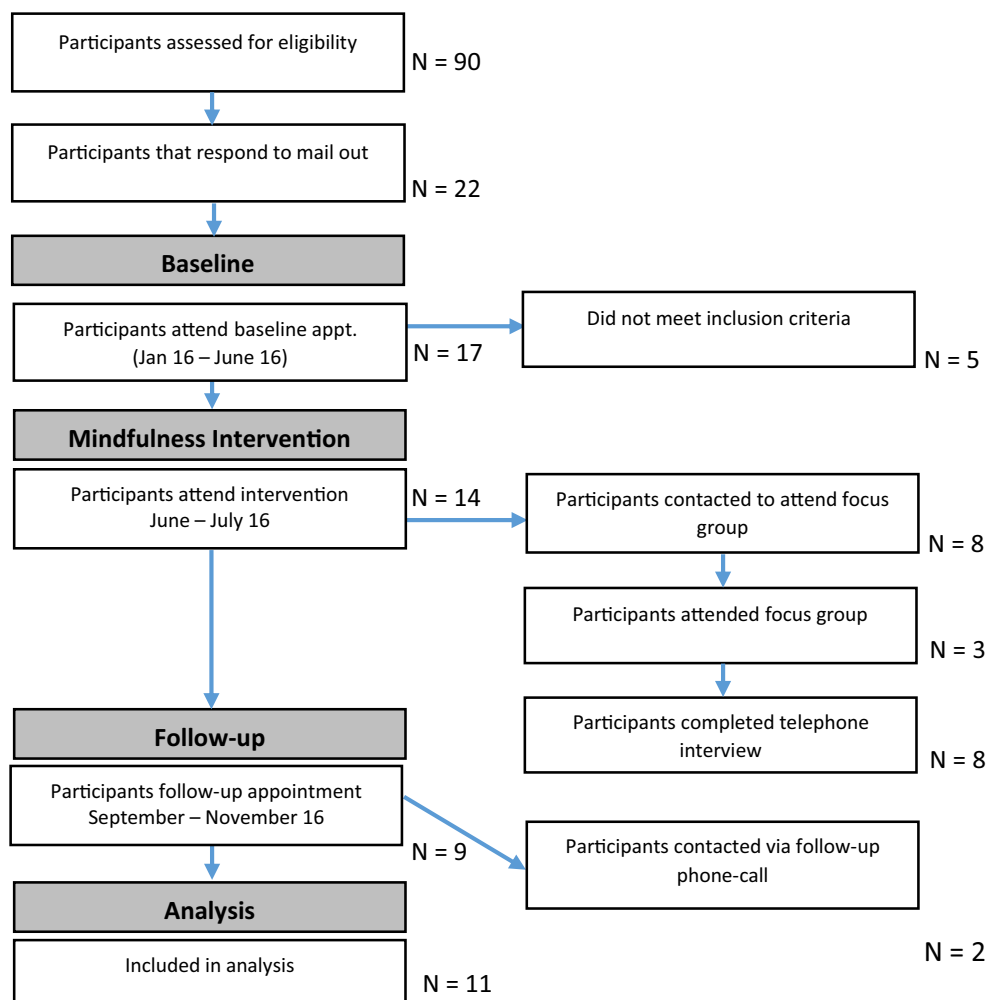
Measures

Feasibility Outcome Measures

Primary feasibility outcomes for the trial were descriptive, examining intervention acceptability and feasibility. These outcomes included patient recruitment to the study, adherence to the intervention and acceptability of the intervention.

Table 2 Detailed description of the mindfulness course content

Week and subject	Description
Week 1: Where is your mind?	Explored the benefits of mindfulness in relation to asthma and specifically how a wandering mind can cause distress; with unchecked patterns of thoughts amplifying anxiety. The core mindfulness skill was attention training, using sensations of the breath in the abdomen (or an external focus such as sound) while cultivating an attitude of acceptance and curiosity. Informal practices were introduced to reduce tension and stress.
Week 2: Reconnecting mind and body	Focused on increasing emotional awareness to have better control over emotions rather than getting caught up in them. The core mindfulness practice was a body scan, increasing awareness of body sensations with a view to be able to use the body as a barometer for emotions arising.
Week 3: Mind games	Explored how our minds can 'play tricks' with us—raising awareness of familiar thought patterns that may be based on false mental models. Appreciating that we often miss the interpretation of experience and that 'thoughts are not facts'. The core mindfulness practice was observing thoughts. Informal practice of a breathing space to take a pause and step out of habituated patterns was introduced.
Week 4: Practice and habit	Focused on establishing an on-going personal practice, learning to take care of ourselves and integrating mindfulness into our daily routine.

Fig. 1 Recruitment flow chart for study

Endpoint Measures

The primary endpoint measure assessed for the study was asthma-related quality of life, measured with the Asthma Quality of Life Questionnaire (AQLQ; Juniper et al. 1992), a 32-item questionnaire that asks participants to assess their wellbeing over the last 2 weeks. The overall score is the mean of all items (7 = not impaired at all, 1 = severely impaired). Cross sectional and longitudinal studies have shown that the AQLQ correlates appropriately with other measures of clinical and generic health status (Juniper et al. 1993). Baseline reliability analysis found high internal reliability amongst items ($\alpha = .97$).

Asthma control was measured with the 6-item Asthma Control Questionnaire (ACQ; Juniper et al. 1999), a shortened version of the ACQ-7 (Juniper et al. 2005). The overall mean score is between 0 (totally controlled) and 6 (severely uncontrolled). Baseline scores had high internal reliability ($\alpha = .94$).

Anxiety and depression were measured with the Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith

1983), a 14-item scale that generates two scores for anxiety (7 items) and depression (7 items). Higher scores indicate increased anxiety/depression. Baseline scores had moderate internal reliability for anxiety ($\alpha = .54$) and high for depression ($\alpha = .76$).

State and trait anxiety were also measured using the State-Trait Anxiety Inventory (STAI; Spielberger et al. 1999), a 40-item questionnaire that assesses state anxiety (20 items) and trait anxiety (20 items). Participants rate their agreement with statements such as ‘I feel tense’ on a scale of 0 (Not at all) to 3 (Very much so). Higher overall sum scores are indicative of higher levels of anxiety. Baseline scores had high internal reliability for state ($\alpha = .92$) and trait anxiety ($\alpha = .87$).

Symptoms of dysfunctional breathing were measured with the Nijmegen Questionnaire (NQ; Van Dixhoorn and Duivenvoorden 1985), a 16-item questionnaire in which participants rate how often they experience hyperventilation symptoms (e.g. chest pain, dizzy spells) on a 5-point scale from 0 (Never) to 4 (Very Often). Higher overall sum scores indicate increased dysfunctional breathing. Baseline scores had moderate internal reliability ($\alpha = .61$).

Mindfulness was measured with the Mindful Attention Awareness Scale (MAAS; Jermann et al. 2009), a 15-item scale in which participants rate how frequently they have experiences (e.g. ‘I snack without being aware that I’m eating’) from 1 (Almost Always) to 6 (Almost Never). Higher overall mean scores indicate increased mindfulness. Baseline scores had moderately high internal reliability ($\alpha = .79$).

Medication adherence was measured with the Medical Adherence Report Scale - Asthma (MARS-A; Mora et al. 2011), a 10-item scale in which participants rate how often negative medication behaviours (e.g. ‘I avoid using it if I can’) occur, from 1 (Always) to 5 (Never). Higher overall mean scores indicate better medication adherence. Baseline scores had moderately high reliability ($\alpha = .78$).

Clinical data recorded as part of the WATCH Study (Azim et al. 2019) included lung function (forced expiratory volume in the first second of exhalation (FEV₁) and forced vital capacity (FVC), height, weight, smoking status, diagnosis age and healthcare utilisation including GP visits, hospitalisations and steroid prescription frequency.

Data Analyses

Feasibility outcomes of patient recruitment, retention and intervention adherence were examined descriptively. Intervention acceptability was explored qualitatively using thematic analysis (Braun and Clarke 2006). The key endpoint measure (AQLQ) was examined according to minimum clinically important differences. The feasibility study was not powered to identify statistically significant differences from pre-test to post-test, but exploratory paired comparisons examined changes in self-report measures to inform future power calculations.

Focus group and phone interviews were analysed simultaneously to allow for increased depth of understanding. Inductive thematic analysis (Braun and Clarke 2006) was used to allow themes to emerge from the data and the researcher took a critical realist stance. Three randomly sampled interviews were cross-coded by two members of the research team (AP, BA) and an additional experienced qualitative researcher, in order to generate codes that were then applied to the remaining interview data. NVivo 11 was used to manage the data. Codes were cross-referenced across transcripts and collapsed/merged where possible until key themes emerged, which were reviewed and discussed within the research team. Themes relating to the acceptability and feasibility of the mindfulness intervention are reported below, with verbatim quotes to illustrate key insights.

Results

Recruitment and Adherence

Of 275 patients in the WATCH study, 90 potential eligible participants were identified and contacted via letter, in which they were asked to attend a baseline appointment in the laboratory at the Southampton General Hospital. Twenty-two patients responded to the mailout. Some patients who did not want to take part did give reasons: too far to travel for study ($N = 2$), family/child commitment ($N = 2$), too unwell to take part ($N = 5$), not interested in study ($N = 5$), involved in other asthma studies ($N = 10$) and other reasons ($N = 10$). Some patients did not attend baseline ($N = 5$) and 19 did not respond to the mailout or follow-up phone calls. Seventeen patients attended the baseline appointment during which they completed self-report questionnaire measures. Nine patients attended the 3-month follow-up appointment and 2 patients completed the primary outcome via follow-up phone call (see Fig. 1). Fourteen patients attended 1 mindfulness session, 11 attended the second session, 9 attended the third session and 6 patients attended all 4 mindfulness sessions. Facilitators and barriers to attendance were explored in qualitative focus groups and interviews. Independent t test comparisons explored baseline differences between participants who fully engaged with mindfulness practice (≥ 3 mindfulness sessions attended, $N = 9$) and participants who did not (≤ 2 mindfulness sessions attended, $N = 8$). Engaged participants had better asthma control $M 2.1$, $SD 1.2$) than participants who did not ($M 3.4$, $SD 1.2$; $t_{(15)} = 2.30$, $p = .04$) but did not differ significantly in other measures.

Changes to Self-Report Measures from Baseline to Follow-up

At follow-up, patients had improved anxiety scores (as measured by the HADS), and non-significantly improved mean scores across all other outcomes, with the exception of medication adherence. Baseline, follow-up scores change scores calculated through paired t test comparisons are reported in full in Table 3.

In the key outcome measure (AQLQ), 9 of 11 patients had improved quality of life. Four of 11 patients had improved AQLQ scores greater than 0.5, while one patient had reduced quality of life score greater than 0.5.

Independent t test comparisons found no significant differences in outcome delta scores (i.e. change from baseline to follow-up) between participants who completed ≥ 3 mindfulness sessions vs. participants who did not, nor significant differences in follow-up scores. Bivariate correlations found no associations between mindfulness ‘dosage’ (number of sessions attended) and delta scores or follow-up scores.

Table 3 Mean (SD) baseline and follow-up self-report measures across patients who completed follow-up measures

Measure	Baseline measures (Per protocol, $N = 11$)	3-month follow-up (per protocol, $N = 11$)	Change score M (95% CIs)
Quality of life (AQLQ)	4.14 (1.29)	4.55 (1.44)	+ 0.41 (− 0.16, 0.98)
Asthma control (ACQ)	2.78 (1.21)	2.55 (1.54)	− 0.22 (− 1.20, 0.75)
Anxiety (HADS-A)	8.67 (3.16)	7.00 (4.30)	− 1.67 (− 3.18, − 0.18)
Depression (HADS-D)	6.91 (4.70)	5.67 (5.74)	− 0.44 (− 2.66, 1.77)
State anxiety (SSAI)	45.4 (4.27)	44.0 (6.32)	− 1.38 (− 6.90, 4.15)
Trait anxiety (STAI)	46.2 (5.38)	42.8 (4.49)	− 3.44 (− 8.91, 2.02)
Nijmegen	23.9 (12.5)	23.1 (12.5)	− 0.78 (− 8.17, 6.61)
Mindfulness	4.85 (0.88)	4.62 (0.63)	− 0.23 (− 1.25, 0.80)
Medication adherence	4.31 (0.45)	4.33 (0.46)	− 0.01 (− 0.31, 0.33)

Two patients attended the intervention but did not attend follow-up appointments, so completed only key outcome measures (AQLQ) via phone

Acceptability and Feasibility of the Intervention

Three females participated in the focus group, and nine individuals (three males, six females) completed semi-structured telephone interviews. The results below describe the overarching themes and subthemes, derived from combined focus group and interviews, focusing on findings specific to the acceptability and feasibility of the mindfulness intervention for our sample population (summarised in Table 4).

Acceptability of Mindfulness

The first theme we report explores the overall acceptability of mindfulness interventions (and mindfulness more broadly) for patients with difficult asthma. There were several subthemes that affected acceptability, including

perceived benefits, previous experience, existing treatment and contextual factors.

Perceived Benefits of Mindfulness Practice Participants reported a range of benefits, including emotional wellbeing and physical wellbeing, and, in particular, improved ability to cope with their asthma and changes to their relationship with medication. All participants frequently referred to ‘calming’ and ‘relaxing’ effects with reduced anxiety and worry, and better coping in stressful situations.

I’d agree with ____ really. I found that I’m a lot less anxious generally and when I feel myself getting anxious I find that I’m able to talk myself down a lot easier...Yes it was a big improvement. I did the breathing and I did the exercises and I made sure I kept my feet

Table 4 Overarching themes and subthemes derived through thematic analysis of qualitative interviews

Overarching theme	Sub-theme
Acceptability of mindfulness	1A: Perceived benefits of mindfulness practice.
	1B: Holistic integration with existing pharmacological treatment.
	1C: Pre-existing beliefs and knowledge impacts engagement and adherence.
	1D: Contextual factors impacting the acceptability of the mindfulness intervention.
Challenges and barriers to mindfulness intervention attendance.	2A: Breath-related difficulties.
	2B: Psychological challenges and barriers.
	2C: Practical barriers to attendance.

on the ground and then generally relaxed and I did feel an awful lot better. It did make a difference.

Another benefit identified was improvements to physical wellbeing, often via improved breathing habits ($N = 7$).

It helps me control my breathing. When you are having a flare-up instead of gasping and breathing through your mouth, it's through your nose, down, close your mouth, body posture, expand - so it does help.

Participants discussed mindfulness as a proactive approach. Individuals were able to be more aware of triggers to prevent an asthma attack, use mindfulness to help control of their existing strategies, or use it to reduce stress and panic linked to an asthma attack ($N = 7$).

It's helped me be pro-active in stopping problems before they become an issues [such as] breathlessness, tiredness, exhaustion. I am able to act upon them, through mindfulness, because I notice and then think I'm going to act upon that rather than sort of, suddenly have to panic and not know what you are going to do, so yes I have found it to be really helpful in being proactive.

Holistic Integration with Existing Pharmacological Treatment

Almost all participants viewed mindfulness as a complementary adjunct therapy to their existing medical care, rather than a replacement or alternative for managing asthma ($N = 9$). Some participants did report that the intervention could change their relationship to medication—by adopting a more mindful approach to it ($N = 7$).

I do not think it's ever stop the medicines – I cannot see me getting off the inhalers and such, but I can see it may help me control what it is that I am doing now.

Participants did note that benefits of mindfulness did not extend to lung function, and that such psychological therapies do not impact a current exacerbation ($N = 4$).

When you have a severe exacerbation, or an infection... no matter how much mindfulness you do, you are not going to think yourself better.

Some participants also noted the possibility that this could impact care for participants who had negative beliefs about pharmacological treatments ($N = 2$), although this was not reported by any participants.

I think you would have to be careful, that perhaps somebody who does not mind taking medication or is suspicious of traditional medication, then perhaps they could seek that as an alternative, which clearly it is not.

Pre-existing Beliefs and Knowledge Impacts Engagement and Adherence Participants identified several factors that affected their views of mindfulness. These included beliefs about non-pharmacological therapies and the degree to which an individual's asthma actually needed an additional treatment.

Several participants had experienced mindfulness or meditation before, which helped them feel comfortable with the exercises ($N = 3$).

I've done vipassana meditation previously that trains you very well in that respect [focusing on the breath] so I was extremely comfortable with that.

Participants who had not experienced mindfulness before reported initial scepticism that was moderated after the intervention ($N = 2$).

I must admit I was very sceptical when I went into it – I thought 'this is going to be a load of rubbish' but actually it worked quite well!

Contextual Factors Impacting the Acceptability of the Mindfulness Intervention There were also several specific contextual factors that participants stated were important to the acceptability of the intervention. Many participants spoke of positive attributes of the mindfulness facilitator, and their role in teaching and normalising the use of mindfulness ($N = 7$).

People aren't shy about taking the tablets for something but doing something like this, people can feel a bit self-conscious. The tutor was talking about her experiences with professional groups and surgeons, and I think that sort of thing will make people feel a bit better, saying that this is not that people who are a bit mental do, it's something that everyone can benefit from.

Also important to participants was the adaptable approach taken to deliver the mindfulness that was used. Participants felt this empowered them by allowing them to adopt an individual approach to mindfulness that was appropriate to them ($N = 8$).

She never once said, "Oh I know how you've been feeling. You must do this". It was very much 'I'm here as a guide'...If they say..."You must do one to five

exercises” that’s a turn off for me but if you say “there’s the tools, lots of different things, what suits you?” [it] gives you the confidence to try it out. She encourages you to try it out and to make it your own.

Some participants were positive about sharing experiences of asthma (and comorbid health conditions) and some found the group to be a motivating factor to attend practice. Participants also valued the reflection and group discussion that is involved in mindfulness practice ($N = 7$).

It was also good being around people who had been struggling for years and hear their stories of how they are managing with the mindfulness... I found that I learnt a lot more from peoples’ feedback about how they found it and everything.

Barriers to Mindfulness Intervention Attendance

All participants identified some challenges and barriers to attending a mindfulness course. We identified three subthemes: breath-related challenges, psychological challenges and practical challenges, all of which were suggested to lead to lower engagement with the mindfulness intervention.

Breath-Related Difficulties Many participants noted initial concerns about ‘focusing on the breath’, a common practice in mindfulness that would involve focusing on the primary area of dysfunction for people with asthma ($N = 6$). Some participants said this was in contrast to their usual ‘avoidant’ processes ($N = 3$).

If you are hyperventilating and you feel like you cannot breathe and someone says focus on your breathing, ‘well I can’t breathe’, it sometimes makes it a bit worse.

Some participants state that this was not always the case; that mindfulness was useful when breathing difficulties were minor but when they became severe practicing mindfulness was not practical ($N = 2$).

Maybe if I was a bit more mindful of the earlier signs of an attack umm it might not be so bad but when I’m already in the throes of it...you cannot breathe, you panic, then everyone’s around you, and your panicking and then the ambulance gets there and, the then the last thing you are thinking about is focusing on being mindful of your breathing – you are just trying to breathe.

Many participants did however find focusing on their breath acceptable with continued practice, and others were

able to engage with mindfulness through initially focusing on non-breath-relevant external objects ($N = 3$).

I found [focusing on breathing] a little bit difficult at first... It’s hard but then when I got it... it’s all second nature... it was a weird sensation at first, but I soon got into it. I think the thing that most surprised me was that it was actually helping... I thought, how can you actually concentrate on what it is that is hurting you or is injuring you, but it seems to [help] it, it really does seem to.

Psychological Challenges and Barriers Some participants stated that social anxiety (e.g. self-consciousness in group environment) were barriers to attendance. This was particularly evident during more physical exercises ($N = 7$).

It was really the [exercises] where you were getting up and trying to do lots of things in front of people, I think that was the worst... when I’m back home I can do it in my own private time, then that’s good.

In contrast with the positive experiences of group treatment reported above, one participant did report the group context difficult and state how it negatively impacted their attendance ($N = 1$).

I feel it wasn’t exactly as accessible, for myself, my sort of anxiety, panic attacks, and depression issues... having a group of people made it harder to be involved and harder to do.

However, participants were able to overcome these difficulties and even found that mindfulness benefited feelings of anxiety ($N = 2$).

I think you think about breathing anyway, but I think mindfulness helps you to do it in a more positive way rather than the anxiety of ‘I can’t breathe, oh God everyone is looking at me’. I think it’s more a case of like ___ said, you are able to centre into yourself and get control.

Practical Barriers to Attendance Finally, there were several barriers to attending the mindfulness course—such as ill health or lack of time due to work or family. Participants with difficult asthma typically have multiple health issues that can impact engagement with weekly group sessions ($N = 11$).

I mean 4 weeks is not that big a commitment, but if you have got families or whatever that could be difficult.

As well as difficulties attending group sessions, many participants found it hard to complete daily practice at home due to family and work ($N = 5$).

The difficulty with this whole thing is finding the time to do it when I'm not going to be disturbed.

Discussion

This study examined mindfulness in a difficult asthma population. Our findings demonstrate that mindfulness-based interventions are acceptable and can offer significant benefits for some patients. This population experiences frequent psychological distress and comorbid anxiety and is likely to benefit from psychological and behavioural interventions that can complement existing pharmacological treatment. This is in line with calls for improved psychosocial care for patients with long-term conditions such as asthma.

Our findings support the notion that mindfulness can benefit patients by improving anxiety and stress, which is consistently related to worse asthma-related outcomes—demonstrated by Pbert et al. (2012) in a milder asthma population. This is in line with the benefits of mindfulness-based stress reduction and mindfulness-based cognitive therapy for conditions such as anxiety, depression, pain and IBS through reducing negative elaborative thoughts such as worry and rumination. Our exploratory quantitative results showed improvements of relatively large magnitude to asthma-specific quality of life, indicating the potential for mindfulness-based interventions, although this needs to be further examined in a fully-powered trial. In conjunction with recent evidence that anxiety worsens longitudinal outcomes for people with asthma (Rimington et al. 2001) mindfulness-based treatments may also confer some benefit by mitigating the impact of anxiety and allowing patients to fully benefit from reduced disease symptoms after pharmacological treatment.

Indeed, these findings were in line with our quantitative analysis, our qualitative research demonstrated that mindfulness was found to be an acceptable intervention with participants reporting both physical and psychological benefits. These benefits were reported for both asthma and more general wellbeing, including the frequent comorbidities that are reported by patients with difficult asthma. In particular, participants highlighted the benefits of mindfulness towards stress and anxiety, both specific to asthma and more broadly.

Notably, we also showed that mindfulness-based treatments can effectively complement existing pharmacological therapy, with no indication that medication adherence would be negatively impacted. Notably, difficult asthma patients (with high levels of breathlessness and negative breath-related symptoms) did not experience problems with

increased attentional focusing towards their breath and in fact found mindfulness to improve their subjective experience.

Recruitment to the study was challenging for some patients—some patients opted not to take part despite experimental measures being taken in an unobtrusive, convenient setting. Scores across all measures were similar to the overall cohort of patients with difficult asthma (such as raised levels of anxiety and depression) and careful consideration is needed to ensure that further studies maximise recruitment opportunities and therefore treatment benefits for this population. Reasons given for low uptake were commonly focused around limited time and motivation, as well as many patients in the difficult asthma population who were engaged in pharmacological studies. Even after baseline appointments, patient adherence to the intervention was limited, with 8 (of 17) participants not attending more than 2 mindfulness sessions. Perceived barriers to attendance were both psychological (for example, self-consciousness in group settings) and practical (for example, family and work commitments). However, we did not observe any association between dosage and outcome. This is possible because of the individual variation in thresholds for effective engagement (Ainsworth et al. 2017), i.e. some participants conferred benefit from fewer sessions than others. Further research should examine the degree to which acute mindfulness interventions can offer benefits to patients with difficult asthma while limiting the burden of treatment, for example using digital interventions.

Limitations and Future Research

This pragmatic, observational feasibility trial does have several limitations. Despite the large magnitude of change from baseline to follow-up asthma-specific quality of life score, our study was a feasibility study that was not powered to detect changes in outcomes from baseline to follow-up. In addition to this, the lack of control group means that we cannot infer any causal benefits of mindfulness to our patient population, and cannot separate benefits of the intervention from non-specific benefits of (i) taking part in research more generally and (ii) existing treatments that patients were receiving. Indeed, without randomisation it may be that the participants who signed up for our study were committed and motivated to take part (and as such would also have benefited from a non-active control group). Indeed, we specifically recruited participants with increased anxiety, so the reduction we observed may reflect regression to the mean. Furthermore, several participants did not complete follow-up measures and it is possible that these participants received less benefit than those who did complete follow-up measures. However, our sample included diverse groups across age, gender and education (although not ethnicity) and we are confident that our findings can be used to inform larger, well-powered trials that can determine the effectiveness of mindfulness for difficult asthma patients vs. controls.

Such future trials can benefit from our qualitative analysis of intervention acceptability and feasibility, which allows us to understand the different ways that mindfulness can provide benefits for patients with difficult asthma, and the degree to which it can effectively complement patients' existing pharmacological treatment.

Our results indicate that our primary outcome of asthma-specific quality of life is a satisfactory measure to reflect how mindfulness can impact both (i) asthma-related impaired quality of life and (ii) impaired quality of life related to anxiety/stress. Medication adherence should also be monitored and measures of anxiety should also be measured in order to evaluate likely mediators of improvement.

Indeed, any further trial must carefully consider the nature of the mindfulness intervention offered (and the degree to which it should). Our qualitative data indicate that any mindfulness intervention offered to patients with difficult asthma should target both asthma-related psychological dysfunction (e.g. providing support during episodes of hyperventilation) and psychological dysfunction more broadly (e.g. anxiety and stress). In particular, our study found that a relatively common perceived barrier to uptake—a concern about extensive focus on the breath—was not a problem to many participants. Future mindfulness interventions could therefore overcome this barrier for people with difficult asthma by offering reassurance and support at an early stage (for example, during the recruitment process).

One viable option is to offer a digitally supported mindfulness intervention for people with difficult asthma that would address recruitment/uptake barriers raised by patients in our study (such as social anxiety or physical difficulties with attending weekly practice). In addition to this, digital interventions are a cost-effective method of providing tailored content that could be easily personalised to address individual motivations for engagement and adherence (for example, reminders to complete practice before bedtime).

Acknowledgements The authors would like to acknowledge the role in this manuscript of Professor George Lewith, who sadly passed away during the course of this project. Professor Lewith was involved in the design and planning of the project.

The authors would like to thank Rosie Underhill, Esme Bain, Jonathan Griffiths, Alannah Morgan and Megan Liddiard for their contributions to the project.

Author Contributions BA designed the study, supervised data collection, analysed the data and lead the manuscript preparation. AP performed qualitative data collection and analysis and contributed to manuscript preparation. CE lead qualitative data collection and analysis and contributed to the manuscript preparation. GD designed and delivered the intervention. RK contributed to study design, data collection and manuscript preparation. MT had a major role in study design, data collection, data analysis and manuscript preparation. All authors saw and approved the final manuscript.

Funding Information The study was supported by a research project grant from the NIHR School of Primary Care (FR13:273). During the study BA

was supported by an NIHR Post-doctoral Translational Fellowship from the NIHR School of Primary Care. The funding body had no input into design, analysis or interpretation of data, nor any input into the manuscript. The views expressed are those of the authors and not necessarily those of the NIHR, MRC, the NHS or the Department of Health.

Data Availability The datasets and analysis scripts supporting the conclusions of this article are archived in the FIGSHARE repository: <https://doi.org/10.6084/m9.figshare.5776704.v1>.

Compliance with Ethical Standards

Conflict of Interest Neither Mike Thomas nor any member of his close family has any shares in pharmaceutical companies. In the last 3 years he has received speaker's honoraria for speaking at sponsored meetings or satellite symposia at conferences from the following companies marketing respiratory and allergy products: GSK, Novartis. He has received honoraria for attending advisory panels with; Boehringer Ingelheim, GSK, Novartis. He is a recent member of the BTS SIGN Asthma guideline steering group and the NICE Asthma Diagnosis and Monitoring guideline development group. Ben Ainsworth has received fees for an educational lecture for Astra Zeneca UK and an advisory panel for Roche Ltd. AP, CE, GD and RK have no potential competing interests to declare.

Ethics Approval and Consent to Participate Ethical approval was given by the South Central Berkshire B Research Ethics Committee, reference 15/SC/0522. All participants consented to participate in the study. All participants completed consent forms assenting to anonymised quotes being used in this manuscript.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Ainsworth, B., Steele, M., Stuart, B., Joseph, J., Miller, S., Morrison, L., et al. (2017). Using an analysis of behavior change to inform effective digital intervention design: How did the PRIMIT website change hand hygiene behavior across 8993 users? *Annals of Behavioral Medicine*, 51(3), 423–431. <https://doi.org/10.1007/s12160-016-9866-9>.
- Azim, A., Mistry, H., Freeman, A., Barber, C., Newell, C., Gove, K., et al. (2019). Protocol for the Wessex AsThma CoHort of difficult asthma (WATCH): a pragmatic real-life longitudinal study of difficult asthma in the clinic. *BMC Pulmonary Medicine*, 19(1), 99. <https://doi.org/10.1186/s12890-019-0862-2>.
- Barton, C. A., McKenzie, D. P., Walters, E. H., Abramson, M. J., & Group, T. V. A. M. S. (2005). Interactions between psychosocial problems and management of asthma: who is at risk of dying? *Journal of Asthma*, 42(4), 249–256. <https://doi.org/10.1081/JAS-200057881>.
- Bender, B. G. (2006). Risk taking, depression, adherence, and symptom control in adolescents and young adults with asthma. *American*

- Journal of Respiratory and Critical Care Medicine*, 173(9), 953–957. <https://doi.org/10.1164/rccm.200511-1706PP>.
- Bowen, D. J., Kreuter, M., Spring, B., Cofta-Woerpel, L., Linnan, L., Weiner, D., et al. (2009). How we design feasibility studies. *American Journal of Preventive Medicine*, 36(5), 452–457. <https://doi.org/10.1016/j.amepre.2009.02.002>.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
- Carmody, J., & Baer, R. (2009). How long does a mindfulness-based stress reduction program need to be? A review of class contact hours and effect sizes for psychological distress. *Journal of Clinical Psychology*, 65(6), 627–638. <https://doi.org/10.1002/jclp.20555>.
- Crowe, M., Jordan, J., Burrell, B., Jones, V., Gillon, D., & Harris, S. (2016). Mindfulness-based stress reduction for long-term physical conditions: a systematic review. *Australian & New Zealand Journal of Psychiatry*, 50(1), 21–32. <https://doi.org/10.1177/0004867415607984>.
- Demoly, P., Gueron, B., Annunziata, K., Adamek, L., & Walters, R. D. (2010). Update on asthma control in five European countries: results of a 2008 survey. *European Respiratory Review*, 19(116), 150–157. <https://doi.org/10.1183/09059180.00002110>.
- Edwards, M. R., Saglani, S., Schwarze, J., Skevaki, C., Smith, J. A., Ainsworth, B., et al. (2017). Addressing unmet needs in understanding asthma mechanisms. *European Respiratory Journal*, 49(5), 1–30. <https://doi.org/10.1183/13993003.02448-2016>.
- Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L., & Lancaster, G. A. (2016). CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *Pilot and Feasibility Studies*, 2(1), 64. <https://doi.org/10.1186/s40814-016-0105-8>.
- Global Asthma Network. (2018). *The global asthma report 2018*. Auckland: New Zealand.
- Janssens, T., Verleden, G., De Peuter, S., Van Diest, I., & Van den Bergh, O. (2009). Inaccurate perception of asthma symptoms: a cognitive-affective framework and implications for asthma treatment. *Clinical Psychology Review*, 29(4), 317–327. <https://doi.org/10.1016/j.cpr.2009.02.006>.
- Janssens, T., Verleden, G., De Peuter, S., Petersen, S., & Van den Bergh, O. (2012). Predicting asthma treatment outcome at diagnosis: the role of symptom perception during a histamine challenge test. *Journal of Asthma*, 49(3), 230–236. <https://doi.org/10.3109/02770903.2012.656864>.
- Jermann, F., Billieux, J., Laroï, F., d'Argembeau, A., Bondolfi, G., Zermatten, A., & Van der Linden, M. (2009). Mindful attention awareness scale (MAAS): psychometric properties of the French translation and exploration of its relations with emotion regulation strategies. *Psychological Assessment*, 21(4), 506–514. <https://doi.org/10.1037/a0017032>.
- Juniper, E. F., Guyatt, G. H., Epstein, R. S., Ferrie, P. J., Jaeschke, R., & Hiller, T. K. (1992). Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials. *Thorax*, 47(2), 76–83. <https://doi.org/10.1136/thx.47.2.76>.
- Juniper, E. F., Guyatt, G. H., Ferrie, P. J., & Griffith, L. E. (1993). Measuring quality of life in asthma. *American Review of Respiratory Disease*, 147(4), 832–838. <https://doi.org/10.1164/ajrccm/147.4.832>.
- Juniper, E. F., O'Byrne, P. M., Guyatt, G. H., Ferrie, P. J., & King, D. R. (1999). Development and validation of a questionnaire to measure asthma control. *European Respiratory Journal*, 14, 902–907. <https://doi.org/10.1034/j.1399-3003.1999.14d29.x>.
- Juniper, E. F., Svensson, K., Mörk, A.-C., & Ståhl, E. (2005). Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. *Respiratory Medicine*, 99(5), 553–558. <https://doi.org/10.1016/j.med.2004.10.008>.
- Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain and illness*. Delta.
- Lavoie, K. L., Bacon, S. L., Barone, S., Cartier, A., Ditto, B., & Labrecque, M. (2006). What is worse for asthma control and quality of life: depressive disorders, anxiety disorders, or both? *Chest*, 130(4), 1039–1047. <https://doi.org/10.1378/chest.130.4.1039>.
- Lavoie, K. L., Bouthillier, D., Bacon, S. L., Lemièrre, C., Martin, J., Hamid, Q., et al. (2010). Psychologic distress and maladaptive coping styles in patients with severe vs moderate asthma. *Chest*, 137(6), 1324–1331. <https://doi.org/10.1378/chest.09-1979>.
- Malpass, A., Kessler, D., Sharp, D., & Shaw, A. (2015). MBCT for patients with respiratory conditions who experience anxiety and depression: a qualitative study. *Mindfulness*, 6(5), 1181–1191. <https://doi.org/10.1007/s12671-014-0370-7>.
- Mora, P. A., Berkowitz, A., Contrada, R. J., Wisnivesky, J., Home, R., Leventhal, H., & Halm, E. a. (2011). Factor structure and longitudinal invariance of the Medical Adherence Report Scale-Asthma. *Psychology & Health*, 26(6), 713–727. <https://doi.org/10.1080/08870446.2010.490585>.
- Moy, M. L., Lantin, M. L., Harver, A., Schwartzstein, R. M., & Carolina, N. (1998). Language of dyspnea in assessment of patients with acute asthma treated with nebulized albuterol. *American Journal of Respiratory and Critical Care Medicine*, 158, 749–753. <https://doi.org/10.1164/ajrccm.158.3.9707088>.
- Pbert, L., Madison, J. M., Druker, S., Olendzki, N., Magner, R., Reed, G., et al. (2012). Effect of mindfulness training on asthma quality of life and lung function: a randomised controlled trial. *Thorax*, 67(9), 769–776. <https://doi.org/10.1136/thoraxjnl-2011-200253>.
- Rimington, L. D., Davies, D. H., Lowe, D., & Pearson, M. G. (2001). Relationship between anxiety, depression, and morbidity in adult asthma patients. *Thorax*, 56, 266–271. <https://doi.org/10.1136/thorax.56.4.266>.
- Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, 62(3), 373–386. <https://doi.org/10.1002/jclp.20237>.
- Spielberger, C. D., Sydeman, S. J., Owen, A. E., & Marsh, B. J. (1999). Measuring anxiety and anger with the state-trait anxiety inventory (STAI) and the state-trait anger expression inventory (STAXI). In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment* (pp. 993–1021). Lawrence Erlbaum Associates Publishers.
- Spinhoven, P., van Peski-Oosterbaan, A. S., Van der Does, A. J., Willems, L. N., & Sterk, P. J. (1997). Association of anxiety with perception of histamine induced bronchoconstriction in patients with asthma. *Thorax*, 52(2), 149–152. <https://doi.org/10.1136/thx.52.2.149>.
- Stanescu, S., Kirby, S. E., Thomas, M., Yardley, L., & Ainsworth, B. (2019). A systematic review of psychological, physical health factors, and quality of life in adult asthma. *NPJ Primary Care Respiratory Medicine*, 29(1), 1–11. <https://doi.org/10.1038/s41533-019-0149-3>.
- Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V., Soulsby, J., & Lau, M. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology*, 68, 615–623. <https://doi.org/10.1037/0022-006X.68.4.615>.
- Thomas, M., Bruton, A., Moffat, M., & Cleland, J. (2011). Asthma and psychological dysfunction. *NPJ Primary Care Respiratory Medicine*, 20(3), 250–256. <https://doi.org/10.4104/pcrj.2011.00058>.
- Van Dixhoorn, J., & Duivenvoorden, H. J. (1985). Efficacy of Nijmegen Questionnaire in recognition of the hyperventilation syndrome. *Journal of Psychosomatic Research*, 29(2), 199–206. [https://doi.org/10.1016/0022-3999\(85\)90042-X](https://doi.org/10.1016/0022-3999(85)90042-X).
- Wainwright, N. W. J., Surtees, P. G., Wareham, N. J., & Harrison, B. D. W. (2007). Psychosocial factors and incident asthma hospital admissions in the EPIC-Norfolk cohort study. *Allergy*, 62(5), 554–560. [https://doi.org/10.1016/0022-3999\(85\)90042-X](https://doi.org/10.1016/0022-3999(85)90042-X).
- Yii, A. C. A., & Koh, M. S. (2013). A review of psychological dysfunction in asthma: affective, behavioral and cognitive factors. *Journal of Asthma*, 50(9), 915–921. <https://doi.org/10.3109/02770903.2013.819887>.

- Yorke, J., Fleming, S. L., & Shuldham, C. (2007). Psychological interventions for adults with asthma: a systematic review. *Respiratory Medicine*, *101*(1), 1–14. <https://doi.org/10.1016/j.rmed.2006.04.003>.
- Yorke, J., Fleming, S., Shuldham, C., Rao, H., & Smith, H. E. (2015). Nonpharmacological interventions aimed at modifying health and behavioural outcomes for adults with asthma: a critical review. *Clinical and Experimental Allergy*, *45*(12), 1750–1764. <https://doi.org/10.1111/cea.12511>.
- Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*(6), 361–370. <https://doi.org/10.1186/1477-7525-1-29>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.