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Mindfulness-based intervention in patients with persistent pain in chest (MIPIC) of non-cardiac cause: a feasibility randomised control study

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ABSTRACT

Objective The study evaluated the feasibility of mindfulness-based cognitive therapy (MBCT) in patients with non-cardiac chest pain by assessing their willingness to participate and adhere to the programme, and for these data to help further refine the content of MBCT for chest pain.

Patients and methods This prospective 2:1 randomised controlled trial compared the intervention of adapted MBCT as an addition to usual care with just usual care in controls. Among 573 patients who attended the rapid access chest pain clinic over the previous 12 months and were not diagnosed with a cardiac cause but had persistent chest pain were invited. The intervention was a 2-hour, weekly, online guided 8-week MBCT course. Compliance with attendance and the home practice was recorded. Enrolled patients completed the Seattle angina questionnaire (SAQ), Hospital Anxiety and Depression Scale, Cardiac Anxiety Questionnaire, Five-Facet Mindfulness Questionnaire, and Euro Quality of Life–5 Dimensions–5 Level at baseline assessment and after 8-week period.

Results Persistent chest pain was reported by 114 patients. Of these, 33 (29%) patients with a mean age of 54.2 (±12.2) years and 68% women, consented to the study. Baseline questionnaires revealed mild physical limitation (mean SAQ, 76.8±25), high levels of anxiety (76%) and depression (53%), modest cardiac anxiety (CAQ,1.78±0.61) and mindfulness score (FFMQ, 45.5±7.3). Six patients subsequently withdrew due to bereavement, caring responsibilities and ill health. Of the remaining 27 participants, 18 in the intervention arm attended an average of 5 sessions with 61% attending ≥6 sessions. Although not statistically powered, the study revealed a significant reduction in general anxiety, improved mindfulness and a trend towards improvement in SAQ scores in the intervention arm.

Conclusion One-third of patients with persistent non-cardiac chest pain were willing to participate in mindfulness-based therapy. An improvement in anxiety and mindfulness was detected in this feasibility study. A larger trial is required to demonstrate improvement in chest pain symptoms.

WHAT IS ALREADY KNOWN ABOUT THIS SUBJECT?

⇒ Around half of the patients presenting to chest pain clinics continue to have chest pain despite the exclusion of a cardiac cause and one-third of these also have high levels of anxiety and depression. cognitive–behavioural therapy, as an established psychological therapy, has shown mixed results in reducing chest pain. More recently, mindfulness-based interventions (MBI) have shown small improvements in chronic pain in other parts of the body but have not been used for chest pain.

WHAT DOES THIS STUDY ADD?

⇒ This study establishes the feasibility of conducting MBI in patients with chest pain and demonstrated a similar degree of willingness and compliance as seen in other studies with pain in other parts of the body. MBI significantly reduced anxiety and improved mindfulness with trend towards reducing depression and improving chest pain parameters.

HOW MIGHT THIS IMPACT ON CLINICAL PRACTICE?

⇒ As chest pain continues to persist in one-third of patients without a cardiac cause alongside associated anxiety and depression, MBIs may be a useful alternative that empowers patients, reduce dependence on analgesics and opioids, and reduce attendance to general practitioners and hospitals. However, the efficacy of MBIs in reducing chest pain has to be explored in a larger study.

BACKGROUND

Pain is a complex biopsychosocial experience and is defined as an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage.[1] When occurring in the chest, pain can have several causes and patients can present acutely or as non-acute stable chest pain (SCP).[2] SCP is a common symptom in general practice accounting

for 1%–3% of patient attendances.[3 4] In the UK, these patients are referred to the rapid access chest pain clinics (RACPC) in secondary care[5] where they are assessed to exclude significant coronary artery disease (CAD) or other cardiac causes of pain as per the National Institute for Health and Care Excellence guidance.[2]

Only up to 10% of RACPC patients with SCP are found to have a cardiac cause due to significant CAD,[5 6] requiring treatment with anti-anginal medications, or coronary revascularisation. Approximately 23% of patients are diagnosed by general practitioners (GPs) to have chest pain due to gastro-oesophageal reflux disease, musculoskeletal problems, pulmonary causes or psychological issues including anxiety, stress and depression. Other patients with no attributable cause (~70%) are characterised as having non-cardiac chest pain (NCCP).[7] The lifetime prevalence of NCCP is 20%–33% compared with 6%–7% for CCP.[8] When pain persists for more than 3 months, it is classified as 'chronic pain', which can be primary or secondary with the latter having an attributable cause.[9]

Limited available data suggest that about half the patients with a diagnosis of NCCP continue to have chest pain symptoms despite the exclusion of a cardiac cause[10] and approximately one-third of patients with NCCP and cardiac chest pain have anxiety and depression.[11 12] The experience of pain is understood to be the result of complex interactions between biological, psychological and sociological factors. There is substantial evidence of the importance of psychological factors in the experience of pain, both in the presence of tissue damage (as with underlying CAD) and its absence (as with NCCP). Biopsychosocial approaches for NCCP should therefore be considered.[8]

Although long-term follow-up indicates low mortality in these patients, continuing chest pain has serious consequences for the patient in terms of patient-reported impact including an impaired quality of life (QOL).[13] Patient concerns regarding an ongoing cardiac condition also result in fear-avoidance of physical activities and increased use of healthcare resources.[12] Adverse psychological states are known to be a strong risk factor for myocardial infarction and cardiovascular death with an incremental predictive power.[14–16] There is evidence that adverse psychological states may also contribute to the recurrence of acute chest pain.[17]

Psychological interventions, particularly cognitive–behavioural therapy (CBT), have been evaluated in patients with NCCP with mixed results.[18–20] CBT offered by trained psychotherapists on an individual basis is a well-established technique. Mindfulness-based intervention (MBI), on the other hand, offered as group therapy, was developed by Dr Jon Kabat-Zinn at the University of Massachusetts Medical Centre in the 1970s as Mindfulness-Based Stress Reduction (MBSR), to reduce and manage chronic physical pain.[21] This approach has been adopted widely with success for the management of anxiety and stress.[22] Mindfulness trains the mind to cultivate awareness in the present moment and decentring from internal experiences resulting from beliefs, thoughts or emotions. This results in supporting an objective and non-judgmental stance to oneself and a greater sense of emotional balance and well-being.[22] Later, MBSR was combined with elements of CBT to form mindfulness-based cognitive therapy (MBCT) which reduces relapse of depression and is an effective alternative to antidepressants.[23–26]

There is emerging evidence that both MBSR and MBCT are effective for pain management (eg, chronic pain,[27] lower back,[28] headaches,[29] fibromyalgia,[30] irritable bowel syndrome (IBS)[31] and cancer[32]). However, as far as we know, there is currently no published study exploring the use of mindfulness in patients with NCCP.

There are various hypothesised mechanisms by which MBIs may improve chronic pain symptomology including increased emotion regulation, openness or acceptance, reduced fear-avoidance or pain catastrophising, behavioural activation.[33] Pain catastrophising (thoughts about pain that are characterised by magnification, rumination and helplessness) is strongly associated with a number of important pain-related outcomes.[34 35] MBIs teach participants skills such as decentring from thoughts and stabilising attention, which are likely to disrupt pathways between the experience of pain and its consequences.[36]

This study explored the feasibility of an adapted MBCT as an intervention in patients diagnosed with NCCP to inform the design and conduct a larger randomised controlled trial (RCT). The primary aim of this study was to evaluate the willingness of patients with persistent NCCP to participate in a mindfulness programme, their compliance and to refine the content of MBCT for this patient cohort. The prevalence of anxiety, depression, state of mindfulness and QOL in these patients was also evaluated.

METHODS

Overall design

This feasibility study was performed as a prospective RCT design with adapted MBCT and usual care in the intervention arm and usual care alone in the control arm. It was designed in consultation with a patient group advising on research in the hospital (comprising of lay people who have been patients previously and volunteer to provide a patient's perspective on new research studies) and a patient representative who took part in the design and conduct of the study

Patients who attended the RACPC in a tertiary cardiac centre between January and December 2019 (n=573) with SCP were retrospectively screened for their diagnosis from the hospital Electronic Patient record and RACPC database (online supplemental figure 1). Those with a diagnosis of a cardiac cause of their chest pain or previous revascularisation were excluded and the remaining patients aged 18–75 years were contacted by

telephone and/or letter to determine the persistence of their symptoms. Patients were excluded if the chest pain had resolved; had a cardiac event or revascularisation; were under psychiatric care or had a new psychoactive drug prescription within the previous 3 months. Those with no access to a computer or tablet device with the internet or who did not adequately understand written and verbal English were also excluded from the study. Patients with persistent chest pain of any intensity who met the inclusion criteria were informed and invited to take part in the study. Written consent was obtained for participation in an 8-week course which included home practice of mindfulness. A simple 2:1 randomisation was followed so that adapted MBCT could be experienced and evaluated by more participants. The random allocation sequence was generated by the statistician (WB) and TKM enrolled and assigned participants accordingly.

Research staff performed the initial and follow-up assessments and were not able to be blinded due to the nature of the study.

Initial assessment

At the initial assessment, the eligible patients received an explanation of the study, a short practice of mindfulness and instructions for home practise during the 8-week course. Those who consented to participate in the study provided details of ethnicity, job status, height, body weight, history of cardiovascular risk factors, any non-cardiac diagnoses by GP, alcohol intake, physical activity and current drug therapy.

All participants were subsequently asked to complete the following questionnaires:

1. Seattle Angina Questionnaire (SAQ) with three domains of physical limitation, angina stability and frequency and QOL.[37] Used in multiple RCTs, this questionnaire has been well validated as an objective tool to quantify chest pain and QOL.[38]
2. Hospital Anxiety and Depression scale (HADS) questionnaire. This well-validated questionnaire assesses the two dimensions of general anxiety and depression in patients.[39 40] A cut-off value of ≥8 was taken to represent anxiety or depression.
3. Cardiac Anxiety Questionnaire (CAQ): This questionnaire assessed heart focused anxiety. CAQ consists of 18 items with three subscales for fear, avoidance and heart-focused attention.[41] The scores range from 0 to 4 with higher scores representing greater cardiac anxiety.
4. Five-Facet Mindfulness Questionnaire (FFMQ-15): This 15-item questionnaire measures the mindfulness state of an individual for research purposes. It comprises five domains of observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience.[42]
5. Euro Quality of Life-5 Dimensions-5 Level (EQ-5D-5L): This QOL questionnaire comprises five dimensions of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression; each with 5-options or levels.[43] This includes a Visual Analogue Scale for the patient's self-rating of overall health at the time.

Intervention group: MBCT adaptation and delivery

The standard MBCT course was adapted for patients with chest pain as per recommended guidance[44] by clinical psychologists with >10 years of experience in MBCT including adaptations and teaching (online supplemental table 1). Adaptations were made to increase the relevance of the intervention to those with chest pain, with increased emphasis on chest pain symptoms, the impact of pain on daily life and stress/anxiety (as opposed to depression for which the original programme was designed). This involved minor changes to the content and handout of each session, for example, attending to typical pain cognitions in cognitive exercises and increased guidance for working with unpleasant bodily symptoms in the meditation practices. However, the overall structure of the course, including the core meditation practices, remained the same.

Participants in the intervention arm underwent the adapted MBCT course over 8 weeks while continuing any GP prescribed treatments. Two courses were run on different days and different times conducted using the Zoom online platform by experienced MBCT teachers, who were qualified psychologists or psychotherapists. MBCT sessions were 2 hours in duration except for the first and last week sessions which were 2.5 hours long. An online practice day of 6 hours was held after the sixth session as per the standard MBCT programme for depression. Audio recordings of the teachers and participants were used to supervise and evaluate the adapted MBCT.

After each session, handouts and meditation audio recordings were emailed to the participants. They were invited to practice at home for 45 min for 6 days each week and to record their practice and experience daily in an online questionnaire (SurveyMonkey platform). The latter was used to assess their compliance with different formal and informal practices performed at home and their frequency. Participants could withdraw from the study at any time without giving a reason. Any adverse events arising from the MBCT programme were recorded as per the study protocol.

Control group

Participants in the control arm maintained/continued with any GP-prescribed treatment. They were offered participation in the adapted MBCT course after the follow-up assessment.

Follow-up

Patients from both groups had a single follow-up 1–4 weeks after their 8-week MBCT course or usual care. Patients were asked to complete the online questionnaires, as used at baseline.

Sample size and recruitment

No statistical sample size calculation was performed due to the feasibility nature of this study. A sample size of 50

participants was chosen for this feasibility study based on the attendance to the RACPC in the previous year as demonstrated in online supplemental figure 2.

Statistical analysis

The baseline characteristics of the participants are described with comparisons between those with and without persistent chest pain, and between the intervention and control groups. All continuous variables are presented as mean±SD or median (IQR) while categorical variables are presented as frequencies with percentages. Comparisons between groups were made using the Chi-square test for categorical variables and t-test or Mann-Whitney test for continuous variables. The internal consistency test of the different questionnaires used in the study was performed using Cronbach's alpha. A pairwise comparison was made for those participants who completed the follow-up assessment. The treatment effect was estimated from the difference in means using the two-sample t-test or the Hodges-Lehman estimate for non-normal continuous variables. All statistical analyses were performed using Stata V.16.0 statistical software.

RESULTS

Persistent chest pain and patient enrolment

Out of the 573 patients who attended the RACPC during the 12 months with SCP or equivalent symptoms, 418 (72.9%) fulfilled the eligibility criteria (figure 1). Persistent chest pain was reported by 114 (32%) patients out of 356 patients (62.1%) who could be contacted. The characteristics of patients with persistent pain compared with those with resolved pain as assessed during the RACPC visit are shown in table 1. More patients with persistent CP were diabetic but there was no difference in other characteristics.

Of the 114 patients with persistent chest pain, 33 (29%) agreed to participate and underwent randomisation. Pain not being experienced as problematic was the main reason for non-participation, followed by lack of time/other responsibilities (figure 1).

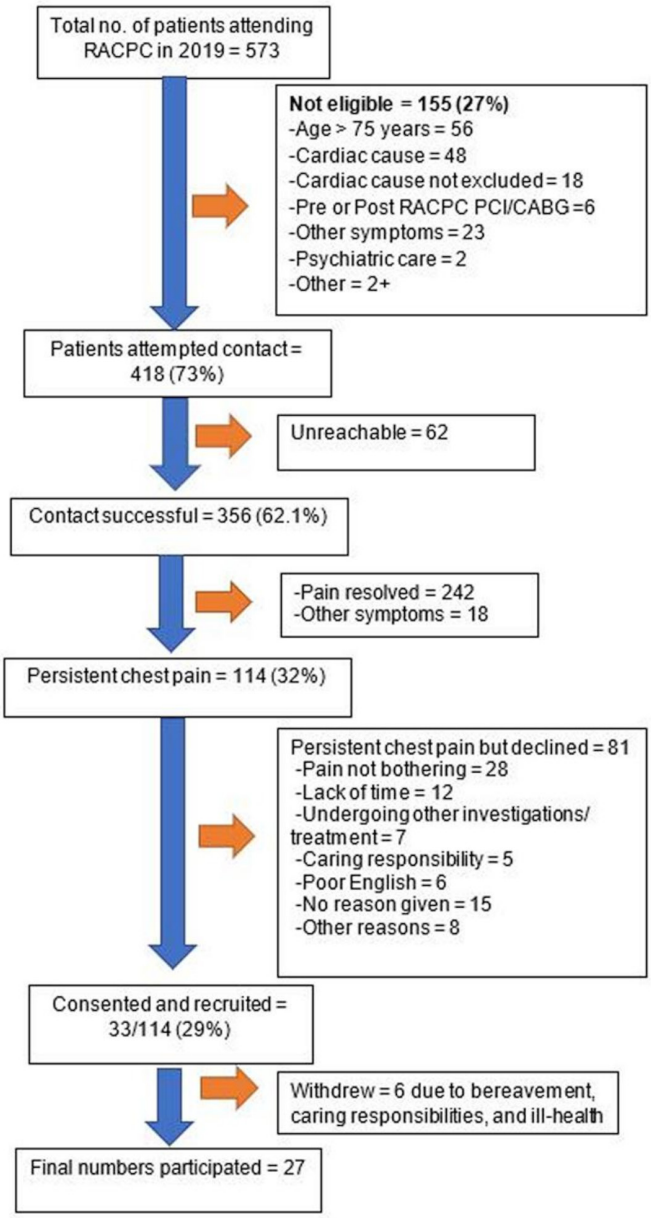

Figure 1 CONSORT diagram of patient recruitment. CABG, coronary artery bypass surgery; CONSORT, Consolidated Standards of Reporting Trials; PCI, percutaneous coronary intervention; RACPC, rapid access chest pain clinic.

Baseline characteristics and comparison between control and intervention groups

Baseline characteristics of the 33 participants are given in table 2. Mean age was 54.2 years (range, 26–72 years) and 22 (68%) were women with no other differences between the two groups. The mean time between attendance at RACPC and the initial assessment for the study was 10.3 months. Chest pain was atypical or non-anginal in 30 of the participants with a mean duration of 18.7 months (±5.5). The prevalence of risk factors, physical activity, alcohol intake and participants drug history are described in table 2 and online supplemental table 2, respectively. Eight participants (24%) had a prediagnosis of both anxiety and depression.

After consent and initial assessment, one participant did not complete the study questionnaires at the baseline and withdrew from the study. Thus, the baseline scoring of questionnaires in table 3 is for the remaining 32 participants. The internal consistency of the SAQ, HADS, CAQ, FFMQ-15 and EQ-5D-5L questionnaires in this study demonstrated a Cronbach's alpha of 0.87, 0.91, 0.73, 0.69 and 0.96, respectively, with an average of 0.95. The SAQ at baseline demonstrated mild physical limitation (mean score 78.6±25), stability in chest pain symptoms and frequency compared with the previous 4 weeks, and moderate to severely reduced QOL score (mean 38.2±25.5). The HADS score ≥8 for anxiety and depression was found in 76% and 53% of all participants with no significant difference between the control and intervention groups. Similarly, a moderate degree of cardiac anxiety was identified in the study group with a

Table 1 Characteristics of patients with persistent and resolved chest pain

Characteristic	All (n=356)	Persistent chest pain (n=114)	No chest pain (n=242)	P value
Age in years, mean (±SD)	54.5 (10.6)	53.9 (10.7)	54.8 (10.6)	0.51
Female sex (%)	191 (56.5)	64 (56.1)	127 (52.5)	0.52
Typical or atypical chest pain (%)	205 (57.6)	73 (64.0)	132 (54.6)	0.34
Hypertension (%)	117 (32.9)	44 (38.6)	73 (30.2)	0.11
Diabetes (%)	45 (12.6)	21 (18.4)	24 (9.9)	0.02
High cholesterol (%)	214 (60.1)	76 (66.7)	138 (57)	0.08
Smoking (%)	46 (12.9)	17 (14.9)	29 (12)	0.44
Family history of premature CAD (%)	79 (22.2)	27 (23.4)	52 (21.5)	0.64
Any imaging performed? (%)	256 (75.7)	88 (77.2)	168 (69.4)	0.13
History of anxiety (%)	46 (13.6)	15 (14)	31 (13.3)	0.34
History of depression (%)	41 (12.1)	15 (14)	26 (11)	0.27
GORD pain (%)	18 (5.3)	8 (7)	10 (4.1)	0.25
MSK pain (%)	7 (2.1)	1 (1)	6 (2.5)	0.31

CAD, coronary artery disease; GORD, gastro-oesophageal reflux disease; MSK, musculoskeletal.

mean score of 1.78. The total mean FFMQ-15 score in its five dimensions was also modest at a mean of 45.5 (±7.3) with no significant difference between groups.

A further five participants withdrew from the study, with the remaining 27 participants (82%) taking part in the study, with 18 in the intervention and 9 in the control group, maintaining 2:1 randomisation. It was only these patients who were included in the final analysis. Reasons for withdrawing from the study included bereavement, caring responsibilities and ill health. The intervention group participants attended an average of 5.3 MBCT sessions with 61% attending ≥6 sessions. An average of 74% participants returned completed home practice questionnaires with a reported frequency of formal meditation practice being 68% (range 53%–90%).

Patient follow-up

The comparison of scores of different questionnaires at initial assessment and follow-up for the two groups is given in table 4 and online supplemental table 3. These demonstrate a significant reduction in general anxiety in the HADS score (p=0.019), trend towards reduction in depression (p=0.07) and a significant improvement in overall FFMQ mindfulness score (p=0.002) in the intervention group compared with the control. The SAQ scores revealed a trend towards chest pain stability, reduction in angina frequency and improvement in the quality-of-life scores. However, no change was seen in the cardiac anxiety and EQ-5D-5L scores.

No adverse event related to the adapted MBCT programme was reported during the course of 8 weeks to the time of follow-up by the participants.

DISCUSSION

In this feasibility study, almost one-third of patients who presented to RACPC were found to have persistent chest pain despite the exclusion of a cardiac cause or treatment for a non-cardiac cause where present. Of these, one-third of patients were willing to participate in MBCT. This is the first study exploring the use of an MBI in patients with NCCP. We will further discuss the results and challenges met in this feasibility study to enable an improved design of a larger RCT.

Prevalence of persistent chest pain

Few studies have evaluated the prevalence of persisting SCP from the contemporary chest pain clinics after a cardiac cause has been excluded. One such study describes ongoing chest pain in almost 50% of patients after a mean time of 8 months since clinic attendance.[10] In this study, 32% of patients reported persistent chest pain after a mean of 10 months. The paucity of data in this common symptom group is probably because patients are generally discharged from cardiology care after the initial evaluation and exclusion of cardiac diagnosis back to their GPs. These patients may have further evaluation and treatment for other causes of NCCP, while others may learn to live with their pain. A few patients may be referred back to the chest pain clinic or may present to the emergency department. Although this group of patients have low mortality, a recent study for the primary care population demonstrated an increased rate of myocardial infarction in those with unattributed NCCP.[7] They may also have reduced QOL as we found in our study.[12]

Study participation, adherence and home practice

The recruitment of patients from chest pain clinics for psychological treatments can be challenging.[45] Patient participation (32%) in our study was consistent with studies using MBIs in patients with other physical pain[28] and CBT in NCCP.[18] One of the main reasons

Table 2 Baseline characteristics of randomised patients

Characteristic	All	MBCT group (n=22)	Control group (n=11)	P value
Participated (%)	27 (82)	18 (82)	9 (82)	
Age in years, mean (±SD)	54 (12.2)	54.2 (12.8)	53.4 (11.4)	0.89
Female sex (%)	22 (68)	15 (68)	7 (64)	0.79
Time between RACPC and assessment, months (±SD)	10.3 (2.1)	10.5 (2.4)	9.8 (1.7)	0.4
Ethnicity				
White (%)	14 (42)	7 (32)	7 (64)	
Asian British (%)	17 (52)	13 (59)	4 (36)	
Black (%)	2 (6)	2 (9)	0	0.23
Employment				
Full time (%)	16 (48)	10 (45)	6 (55)	
Part time (%)	6 (18)	5 (23)	1 (9)	
Unemployed (%)	2 (6)	1 (5)	1 (9)	
Housewife or husband (%)	3 (9)	1 (5)	2 (18)	
Retired (%)	6 (18)	5 (23)	1 (9)	0.5
Chest pain type				
Typical (%)	3 (9)	2 (9)	1 (9)	
Atypical (%)	21 (64)	15 (68)	6 (55)	
Non-anginal (%)	9 (27)	5 (23)	4 (36)	0.74
Other diagnosis				
None (%)	23 (70)	15 (68)	8 (73)	
GORD (%)	4 (12)	2 (9)	2 (18)	
MSK (%)	4 (12)	3 (14)	1 (9)	
Other (%)	2 (6)	2 (9)	0	0.85
BMI, mean (±SD)	28.7 (6.6)	30.6 (6.8)	25.1 (4.5)	0.02
Cardiovascular risk factors				
Hypertension (%)	18 (55)	11 (50	7 (64)	0.46
Diabetes (%)	10 (30)	4 (23)	5 (45)	0.18
High cholesterol (%)	16 (49)	12 (55)	4 (36)	0.47
Current smoker (%)	3 (9)	2 (9)	1 (9)	1
Family history of premature CAD (%)	4 (24)	8 (36)	0	0.02
Anxiety, (%)	10 (30)	8 (36)	2 (18)	0.28
Depression, (%)	9 (27)	6 (27)	3 (27)	1
Physical activity moderate or more (%)	13 (39)	9 (41)	4 (36)	0.8
Alcohol >7 units/week (%)	12 (36)	7 (32)	5 (45)	0.44

BMI, body mass index; CAD, coronary artery disease; GORD, gastro-oesophageal reflux disease; MBCT, mindfulness-based cognitive therapy; MSK, musculo-skeletal; RACPC, rapid access chest pain clinic.

that patients gave for lack of participation was that the chest pain was not bothersome (25%). Unlike other studies, this study included patients with low intensity or frequency of chest pain so that the prevalence of persistent NCCP could be documented. Such people seem to accept the pain and go about their life reassured that a cardiac cause has been excluded. Other reasons given included lack of time, caring responsibilities, or some were still undergoing other investigations for their pain. After enrolment, a further six patients (18%) withdrew from the study due to caring responsibilities, bereavement and ill health. Similar rates of drop-out and completion of MBI has been observed in other studies.[46] The 61% attendance of ≥6 MBCT sessions in our study is a satisfactory compliance rate and comparable to other studies.[28]

Home practice has been hypothesised to be one of the important aspects of MBIs determining their efficacy.[47] A combination of in-session and between sessions regular home practice is considered to be

Table 3 Questionnaire scores at initial assessment

Questionnaire	All (N=32)	Intervention group (n=21)	Control group (n=11)	P value
SAQ, mean (±SD)				
Physical limitation Score	78.6 (25)	74.8 (23.5)	87.0 (27.3)	0.2
Angina Stability Scale	58.6 (25.8)	53.4 (24.7)	70.0 (25.8)	0.09
Angina Frequency Scale	55.0 (28.7)	49.0 (30.7)	68.0 (19.3)	0.08
Quality of Life Scale	38.2 (25.5)	34.5 (24.5)	46.4 (27.1)	0.22
HADS, mean (±SD)				
Anxiety score	11.2 (4.9)	12.0 (4.8)	9.4 (4.7)	0.16
Anxiety score ≥8 (%)	25 (76)	18 (82)	7 (64)	0.39
Depression score	8.1 (4.3)	9.2 (4.0)	1.6 (4.2)	0.03
Depression score ≥8 (%)	17 (53)	13 (59)	4 (40)	0.45
Cardiac anxiety score, mean (±SD)	1.78 (0.61)	1.89 (0.64)	1.53 (0.48)	0.12
FFMQ-15 score, mean(±SD)				
Observing	9.3 (2.8)	9.7 (2.8)	8.3 (2.7)	0.21
Describing	9.1 (2.4)	8.6 (1.9)	10.1 (3.2)	0.1
Acting with awareness	8.9 (2.6)	8.5 (2.4)	9.7 (2.5)	0.25
Non-judging of inner experience	9.1 (2.4)	8.5 (2.2)	10.6 (2.2)	0.01
Nonreactivity of inner experience	8.6 (2.1)	8.5 (2.2)	8.8 (1.9)	0.71
Total score	45.5 (7.3)	43.8 (7.3)	47.5 (6.7)	0.18
EQ-5D-5L questionnaire				
Mobility	1.7 (0.99)	1.72 (0.98)	1.6 (1.07)	0.75
Self-care	1.5 (0.91)	1.5 (0.91)	1.4 (0.97)	0.68
Usual activities	1.9 (1.3)	2.0 (1.3)	1.8 (1.4)	0.75
Pain/discomfort	2.6 (1.1)	2.6 (0.9)	2.4 (1.3)	0.57
Anxiety/depression	2.5 (1.1)	2.5 (1.1)	2.5 (1.3)	1
Health today score	63.7 (22.8)	63.4 (21.7)	64.5 (26.3)	0.9

EQ-5D-5L, Euro Quality of Life-5 Dimensions-5 Level; FFMQ, Five-Facet Mindfulness Questionnaire; HADS, Hospital Anxiety and Depression Scale; SAQ, Seattle Angina Questionnaire.

essential to obtain the maximum therapeutic effects of the MBI.[48] However, there is limited data on the relationship between the degree of home practice and therapeutic effect due to a lack of consistency in the way it is recorded in different studies. Published data suggest an average frequency of formal practice to be 64% (95% CI 60% to 69%) or 29 min a day in one meta-analysis[47] and 21 min over 3.4 days in another meta-analysis.[48] Although we did not ask participants to record the duration of each formal practice, the frequency of 68% was similar.

Online mindfulness classes

MBCT sessions were conducted online using a video-conferencing programme due to COVID-19 pandemic social distancing restriction. There was no obvious reduction in the quality of the online MBCT programme as it was delivered by experienced instructors and as judged from the feedback questionnaires. Participants did, however, express that they would have liked to meet for the customary retreat day as in non-COVID times. Pre-COVID, as well as more recent literature, has demonstrated the effectiveness of online mindfulness delivery particularly when instructor-guided on a video platform.[49 50] A recent study of health anxiety has shown that effectiveness of a complex psychological intervention can be achieved with online contact only.[51]

Prevalence of anxiety and depression

There was a low prevalence of documented history of anxiety or depression (up to14%) during the RACPC visit (table 1) with no difference in patients with or without persistent CP. This is much lower compared with studies where anxiety and depression were assessed at the time of clinic attendance which was not done in our study.[11 12] A higher degree of anxiety during clinic visits is likely to be expected due to anticipation of cardiac disease which resolves once the investigations are negative. However, the prevalence of anxiety and depression was much higher in the 33 enrolled patients being 76% and 53%, respectively. The prevalence of cardiac anxiety was however modest in this study.

Table 4 Change in chest pain, anxiety, depression, mindfulness, quality of life and healthcare resource utilisation in control and MBCT groups

	Control group		MBCT group	
Variable	**Preintervention (n=6)**	**Postintervention (n=6)**	**Preintervention (n=18)**	**Postintervention (n=18)**
SAQ				
PLS	96 (86, 100)	91 (68, 100)	84 (46, 96)	87.5 (54, 100)
ASS	75 (75, 100)	50 (25, 100)	50 (50, 75)	75 (50, 100)
AFS	80 (60, 80)	80 (60, 80)	60 (40, 80)	80 (40, 100)
QOL	44 (25, 75)	44 (13, 63)	31.5 (13, 50)	63 (25, 75)
HADS				
Anxiety				
Anxiety score≥8	9.5 (6, 11)	10 (9, 11)	12.5 (11, 16)	9 (6, 12)
Depression				
Depression score≥8	6.5 (5, 8)	6.5 (3, 9)	8.5 (7, 11)	6.5 (2, 8)
CAQ	1.7 (1.3, 1.9)	1.55 (1.2, 2.1)	1.85 (1.5, 2.0)	1.65 (1.1, 2.2)
FFMQ				
Describing	9 (5, 13)	8.1 (4.3, 12)	8.8 (7.8, 9.8)	10.8 (9.6, 12.1)
Awareness	9.3 (6.5, 12)	9.2 (6.2, 12.1)	8.4 (7, 9.8)	9.6 (8.5, 10.6)
Non-judging	11.3 (9.6, 13)	10 (7.2, 12.8)	8.3 (7.2, 9.4)	9.7 (8.2, 11.1)
Non-reactivity	8.7 (6.3, 11)	8.5 (6.8, 10.2)	8.5 (7.4, 9.6)	10.2 (9, 11.3)
Total score	38.3 (29.3, 47.4)	35.6 (27,5, 44.1)	34 (30.1, 37.3)	40.3 (37.4, 43.3)
EQ-5D-5L				
Mobility	1 (1, 3)	1 (1, 2)	1 (1, 3)	1 (1, 2)
Self-care	1 (1,2)	1 (1, 1)	1 (1, 2)	1 (1, 2)
Usual activities	1 (1, 3)	1 (1, 2)	1.5 (1, 3)	1 (1, 3)
Pain discomfort	2.5 (1, 4)	2 (2, 2)	2 (2, 3)	2 (2, 3)
Anxiety/depression	2.5 (2, 4)	2 (2, 3)	2 (2, 3)	2 (1, 3)
Health today	73.5 (43, 85)	69 (25, 76)	70.5 (50, 75)	78.5 (65, 85)
AD-SUS				
Hospital Inpatient	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)
Hospital Outpatient	1 (0, 1)	0 (0, 0)	0 (0,1)	0 (0, 1)
A&E	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)
GP	1 (1, 1)	1 (1, 1)	1 (0, 2)	1 (1, 2)

A&E, Accident and Emergency; AFS, Angina Frequency Score; ASS, Angina Stability Score; CAQ, Cardiac Anxiety Questionnaire; EQ-5D-5L, Euro Quality of Life-5 Dimensions-5 Level; FFMQ, Five-Facet Mindfulness Questionnaire; GP, general practitioner; HADS, Hospital Anxiety and Depression Scale; MBCT, mindfulness-based cognitive therapy; PLS, Physical Limitation Score; SAQ, Seattle Angina Questionnaire.

Effectiveness of mindfulness for chest pain and psychological factors

There was a positive trend towards improvement in chest pain stability, frequency and QOL in our study. As this study was not powered for this purpose and the follow-up was short, statistical significance was not shown. There was, however, a reduction in anxiety and depression, as well as improvement in overall mindfulness scores. The improvement in QOL with SAQ but not with EQ-5D-5L questionnaire could be due to a small number of participants and a short follow-up.

A recent meta-analysis of 30 RCTs in patients with chronic pain in other parts of the body found mindfulness to be associated with a small effect of improved pain symptoms (19% reduction) compared with treatment as usual, passive controls and education/support groups.[27] The efficacy of mindfulness did not differ with the type of intervention, medical condition or frequency of intervention. There was statistically significant improvement in depression, physical and mental related QOL. However, there was evidence of substantial heterogeneity among studies and possible publication bias resulting in low quality of evidence.

There is interesting emerging research evidence of MBIs in other health conditions which highlight mechanisms of change that are likely to be important in NCCP. For example, an MBI for blood-pressure reduction appears to develop skills that allowed participants to engage more effectively behaviours that lower cardiovascular disease risk with emotion regulation, perceived

stress, interoceptive awareness and attention control likely mechanisms by which change occurs.[52] MBCT for IBS has been found to reduce IBS symptoms and increase the QOL with reduction in maladaptive illness cognitions and reducing biases in self-referent processing of illness and health as possible mechanisms of change.[53]

Besides their effect on pain, the practice of meditation potentially has other beneficial effects on the cardiovascular system. Different MBIs have been shown to increase parasympathetic tone causing increased heart rate variability[54] and reduce resting respiratory rate.[55] There is also an indication of improved myocardial and endothelial function from meditation practice in patients with microvascular angina,[56] and reduction in markers of inflammation.[57 58] MBIs have been shown to reduce hypertension in a recent meta-analysis,[59] contribute to weight loss and blood-sugar levels[60 61] and reduce smoking.[62]

One of the main advantages of non-pharmacological techniques such as MBIs in pain management is reduced utilisation of analgesics, particularly opioids which has reached epidemic proportions in recent years.[63] Besides, through an increased awareness of one's lifestyle, the MBIs can promote self-management and lead to individual empowerment with the potential of improving the overall physical and mental health in the long run. Studies have shown high compliance to mindfulness practice even after 3–4 years and without any side effects, unlike most analgesic medications.[64]

Limitations of the study and lessons for further research

During the initial contact, the potentially eligible RACPC patients were asked about the persistence of pain but not about the intensity or frequency of pain. In a future study, these aspects of chest pain could be incorporated in the screening questionnaire so that patients with higher intensity and frequency who may be more likely to adhere to the MBCT course can be enrolled.

This was a pilot study and thus had a small sample size. However, it demonstrated the proportions of patients with persistent chest pain who may agree to take part in a larger study. We also learnt about the reasons for the patient drop-out of patients during 8 weeks of MBI. In the future, we could offer several MBCT courses starting at frequent intervals at different times on different days allowing improved enrolment and compliance. A longer follow-up will also be required to assess the effectiveness of MBCT in reducing chest pain, improvement in QOL and healthcare utilisation. All these factors would be helpful while designing a larger study.

Although the importance of home practice was emphasised during the initial assessment interview, only three-quarter of participants completed the practice questionnaires. Further improvements in methods of recording of home practice will be required to measure the effect of duration and frequency of practice on any clinical improvement in future studies.

We also did not include any active control treatments such as relaxation exercises or health education. This may be required in the larger trial along with a cost-effective analysis.

CONCLUSION

Almost one-third of patients who presented to RACPC were found to have persistent chest pain despite the exclusion of a cardiac cause or treatment for a non-cardiac cause where present. Of these, one-third of patients were willing to participate in the mindfulness-based therapy with most of them participating in six or more sessions. Although not statistically powered, the study revealed a significant reduction in general anxiety, improved mindfulness and a trend towards improvement in chest pain scores in the intervention arm. A larger trial would be required to demonstrate the effectiveness of MBI in reducing NCCP and offering a potential treatment for this common condition.

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