Chronic Pain and Management Journal
Hollins T, et al. Chron Pain Manag 8: 161.
www.doi.org/10.29011/2576-957X.100061
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Research Article

# Adults in Low and Medium Intensity Group Pain Management Programs Achieve Similar Clinically Significant Outcomes: A Quasi-Experimental Study

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**Citation:** Hollins T, Sadokierski S, Begley D, Khor K, Watson P (2024) Adults in Low and Medium Intensity Group Pain Management Programs Achieve Similar Clinically Significant Outcomes: A Quasi-Experimental Study. Chron Pain Manag 8: 161. DOI: 10.29011/2576-957X.100061

**Received Date:** 17 June 2024; **Accepted Date:** 24 June 2024; **Published Date:** 27 June 2024

**Abstract**

**Background:** Clinical guidelines for adult Pain Management Programs (PMPs) suggest matching program intensity to patient levels of disability and distress. This tertiary adult pain clinic investigated the possibility that a new low-intensity 17-hour group PMP (17-PMP) could provide better value healthcare than an existing medium-intensity 50-hour group PMP (50-PMP). **Methods:** A quasi-experimental two-group within-between design compared clinical effectiveness of the two programs on standardised outcome measures for adults with persistent pain sequentially allocated to 50-PMP (N=53) then 17-PMP (N=50). **Results:** Both programs reported clinically significant improvements by the end of the 5-week program or at 3-month follow-up in measures of pain interference, catastrophizing, self-efficacy, anxiety, stress and the 30-second Chair Stand Test. Pain severity and depression improved in 50-PMP only, though Bayesian testing found evidence of no differences. The Timed Up-and-Go improved in 17-PMP only. Neither program reduced opioid use. Both programs achieved completion rates of over 80%. Completers in both programs rated the active self-management strategies they had learned to be of high importance, with moderate to high confidence in using them. **Conclusions:** The low intensity program achieved similar outcomes on most pain measures compared to the higher intensity program. Uptake of the 17-PMP was rapid, among patients with all levels of disability and distress. It improved access to effective interdisciplinary treatment for adults with persistent pain, using less resources, thus demonstrating better value healthcare.

**Keywords:** Pain management; Persistent or chronic pain; Group program intensity; Self-management of pain

## Introduction

Persistent or chronic pain has a high prevalence in Australia, similar to other developed countries, affecting 20% of adults and 33% of those over 65 years of age [1]. It incurs an estimated annual cost of $139 billion - $12 billion in direct health system cost, $48 billion in lost productivity and $66 billion in suffering and lost in quality of life [1].

People with persistent pain achieve better outcomes when treated by a multidisciplinary team, using a biopsychosocial formulation in an interdisciplinary manner via a Pain Management Program (PMP), compared with unimodal medical treatment or waitlist controls [2,3]. In a PMP, clinicians collaborate in patient assessment and treatment, using shared goals to address the range of factors that maintain or perpetuate pain, as opposed to unimodal medical treatments that seek to reduce pain intensity only [4]. Patients in a PMP who learn and use active self-management strategies like activity pacing and exercise report less pain and improved function [5,6].

Unfortunately, access to PMPs has been difficult. An Australian study "Waiting in Pain" found that in 2012 only 1% of people with chronic pain were able to access a multidisciplinary pain service [7]. By 2021, this had increased to 15%, as the number of adult pain services had increased, with a reduction in the median wait times from 100 days to 60 days. Still, the wait times to access PMPs had remained long, at 80 days to three years [8]. In 2018, waiting time for adults referred to this Multidisciplinary Pain Clinic, in a metropolitan public tertiary referral teaching hospital, were 90 days for initial assessment and a further 90 to 270 days for individual physiotherapy or psychology treatment or the 50-hour group program (50-PMP). These long waiting times prompted a review of the model of care.

Clinical guidelines suggest adult should be assessed for their level of disability and psychological distress and then matched with a PMP of appropriate intensity, measured in hours of attendance. Adults with high levels of disability and psychological distress should participate in high intensity PMPs [9] which provide superior outcomes to lower-intensity PMPs of fewer hours of attendance [10,11]. But high intensity PMPs that typically involve 100-120 hours of attendance over three to four weeks require high levels of clinical resources and are available in only a few metropolitan pain services [8]. Interestingly, the relationship between contact hours ("dose") and outcomes in PMPs is not consistent [12-16]. Low intensity group PMPs can yield non-inferior outcomes compared with higher intensity group PMPs and are a more accessible and cheaper treatment option [17,18]. Some pain services have been offering low-intensity PMPs to patients with persistent pain who have high levels of disability, poor functioning, mood disorders and other comorbidities. However, it is not clear whether these PMPs are clinically effective [19].

Following the review, this pain clinic introduced a new low-intensity 17-hour group PMP (17-PMP). Uptake of the 17-PMP was rapid, among patients with all levels of disability and distress. It solved the waiting time problem by improving access to interdisciplinary treatment for adults with persistent pain, using less clinical resources. The primary aim of this study was to compare the clinical effectiveness of the 17-PMP with the existing medium-intensity 50-hour group PMP (50-PMP).

## Methods

### Study Design

A non-randomised quasi-experimental two-group within-between design was used to compare outcomes for patients who had participated in the two programs. The study was approved by the local research office as a quality assurance and improvement project not requiring participant consent.

### Participants and setting

A sensitivity analysis conducted in G*Power [20] suggested that with 50 participants in each group, this study would be powered at 0.8 with of alpha=0.05 to detect an effect size of 0.57. Consequently, 103 participants who were referred to this multidisciplinary pain management service in a metropolitan public tertiary referral teaching hospital were included in the study. Fifty-three were patients who had attended the 50-PMP from September 2016 to December 2018. This was the only program offered at the time. The second group of 50 patients were free to indicate their preferred program. As only two patients from this cohort opted for the 50-PMP, all were enrolled in the 17-PMP from February to December 2019.

### Treatment Programs

The 50-PMP required attendance on Monday and Friday for six hours each day, with a one-hour lunch break, for five consecutive weeks, and a half-day attendance at the 3-month follow-up. All facilitators are experienced. Each day included 75-90 minutes of exercise facilitated by the physiotherapist (stretching, strengthening and cardiovascular conditioning exercises using treadmills and a local walk), and a 20-minute meditation facilitated by the nurse. Education was provided by the physiotherapist (exercise, pacing physical activity, baseline setting, flare-up management), clinical psychologist (goal setting and motivation, thought management, stress management, communication, structured problem solving), nurse (meditation, sleep hygiene, use of TENS machine), pain physician (pain mechanisms, the science of persistent pain and pain treatments and medications), psychiatrist (anxiety and depression

in the context of persistent pain), dietitian (healthy eating), and occupational therapist (aids for living, return to work/study) and a previous graduate of the program presented their story to the group.

The 17-PMP was adapted by the authors from the Brief Pain Self-Management Program (BPSM) developed at the Pain Management Research Institute at Royal North Shore Hospital in Sydney. It required attendance at an initial two-hour education session at which patients were introduced to pain science and active self-management strategies. Patients were then invited to attend a further 15 hours, involving three hours on one morning or afternoon each week for five weeks, and again at the 3-month follow-up. The sessions were facilitated by only two clinicians, the same experienced physiotherapist and clinical psychologist. The physiotherapist facilitated a 60-minute stretching and strengthening program. Patients were encouraged to do their own cardiovascular exercise between sessions. The psychologist facilitated education on goal setting and pacing activity, stress management and sleep management, communication, and flare-up planning. The facilitators alternated in leading a 20-minute meditation practice.

In both programs, patients had a printed reference manual with supplementary resources to consolidate their learning, and a workbook in which to record within and between-session activities for practice of the active strategies.

**Self-report measures**

The primary outcome measures described below are provided by the Australasian electronic Persistent Pain Outcomes Collaboration (ePPOC) based at the University of Wollongong. The epiCentre platform scores and collates the ePPOC data submitted by patients and clinicians [21].

**Oral Morphine Equivalent Daily Dose (oMEDD):** Patients report the range and doses of opioid medications they are taking daily, and this is converted to an oral morphine equivalent [22].

**Medication Categories:** Patients report all medications they are taking. Clinicians then categorise these as opioids, paracetamol, NSAIDS, antidepressants, anticonvulsants, sedatives, or medicinal cannabinoids. The score is the number of categories, from 0 to 7.

**Body Mass Index (BMI):** Patients report their height in metres and weight in kilograms and the BMI is calculated.

**Brief Pain Inventory Pain Severity (BPI-Severity) and Pain Interference (BPI-Interference):** The BPI was developed as a pain assessment tool for use with cancer patients. It measures both the intensity of pain (sensory dimension) and interference of pain in the patient's life (reactive dimension) with "0" being "No pain" or "No interference" to "10" being "Pain as bad as you can imagine" or "Complete interference" [23]. The pain intensity and interference items are sensitive to change, have adequate internal consistency, acceptable to excellent test-retest reliability, and satisfactory to good construct validity and criterion validity [24].

**Depression Anxiety Stress Scale (DASS-21):** The DASS-21 contains three 7-item self-report scales designed to measure the emotional states of depression, anxiety, and stress. Patients rate how much each statement applied to them in the past seven days from "0", "Not at all," to "3", "Very much or most of the time" [25]. Each subscale score is the total of the seven items (multiplied by two to allow comparison with the DASS-42) and ranges between 0 and 42, with higher scores indicating more severe symptoms. The DASS-21 has good psychometric properties [26].

**Pain Self-efficacy Questionnaire (PSEQ):** The PSEQ contains 10 statements regarding a patient's beliefs about his or her ability to undertake a range of daily tasks and maintain a reasonable quality of life despite pain. Patients rate their confidence on a scale from "0", "Not confident at all," to "6", "Completely confident." Higher total scores indicate greater pain-related self-efficacy. The PSEQ has good internal consistency and test-retest reliability [27].

**Pain Catastrophizing Scale (PCS):** The PCS is a 13-item questionnaire with three subscales measuring the extent to which individuals ruminate, magnify, and feel helplessness about their pain. Patients rate the degree to which they have each thought or feeling when they are experiencing pain, from "0", "Not at all," to "4", "All the time." In this study the total PCS score is used, with higher scores indicative of more severe catastrophization. The PCS shows good reliability and construct validity [28].

**Functional Measures**

**30 second Chair Stand Test (30CST):** The 30CST is a practical functional measure of lower limb strength which directly assesses a patient's ability to rise out of a chair [29]. The patient starts in sitting upright on a standard chair with seat height of approximately 43 cm with their arms across their chest, moves to a full extended standing position and back into an upright seated position as many times as they can in 30 seconds. The number of repetitions completed is recorded. It is noted if they use their arms for assistance. The 30CST is valid and reliable [30].

**Timed Up and Go (TUG):** The TUG assesses several aspects of a patient's mobility, including strength, balance, coordination, and agility. The patient starts in an upright seated position on a standard chair with seat height of approximately 43 cm. They move from sitting to standing, walk forward three metres to a line drawn on the floor (at least one foot must touch the line), turn around and walk back to the chair and sit down. Patients are permitted to use their usual walking aid during the test, and this is noted. The test is completed three times and the average time is recorded. The TUG is valid and reliable [31].

**Pain Active Self-Management Questionnaire (Pain ASMQ):** The authors devised a questionnaire to use at the end of the program to assess the patient's understanding of each active self-management strategy developed over the course of the PMP, and their plans to use each strategy (Hollins T, Sadokierski S, Begley D (Unpublished). The questionnaire uses "Importance and Confidence" rating scales based on the principles of motivational interviewing [32]. Patients rate each strategy in terms of its importance to them, both retrospectively at the start of the program, and now, from "0", "Not at all important," to "10", "Extremely important". Importance is defined as "your belief that you should do it as you understand the benefits." Patients rate their confidence in using each strategy now, from "0", "Not at all confident," to "10", "Extremely confident." Confidence is defined as "your belief that you know how to do it and can do it." The psychometric properties of the Pain ASMQ have not been analysed.

### Procedure

Patients completed standardized questionnaires online or using pen and paper at home, at pre-treatment, immediately post-treatment, and three months after treatment. Functional measure tests were administered by the physiotherapist during the initial, final and follow-up sessions.

### Statistical Analysis

A linear mixed model was performed in Jamovi Version 1.6 [33]. This type of ANOVA is useful in a quasi-experimental design where the absence of random allocation to programs introduces between program variability. Mixed models handle missing data by estimating parameters for repeated measures studies using maximum likelihood estimation. Inferential tests were based on an automatic selection of the degrees of freedom for the t-tests and the F-tests using the Satterthwaite approximation [34]. Effect size measured as standardised mean difference (Cohen's d) for each outcome was compared from pre-treatment to post-treatment, and from pre-treatment to follow-up, both within each program and between programs. An effect size of 0.5 or greater will be deemed clinically significant, as it has been found to be suggestive of a reliable improvement in pain and health-related quality of life in chronic conditions [35,36].

In the linear mixed model, for each outcome there were two planned comparisons within each program (pre- versus post- and pre- versus follow-up) and a test of the interaction of Program x Time. Statistical significance was set at p=0.05 for all tests, with Bonferroni adjustment for each of these five comparisons.

An analysis of the baseline characteristics of dropouts and completers within and between programs used two-way ANOVAs, with Bonferroni adjustment for these three comparisons. A secondary analysis explored any differences between the programs on the Pain Active Self-Management Questionnaire (Pain ASMQ) using non-parametric tests.

The null and alternative hypotheses were that the 50-PMP was not superior / was superior to the 17-PMP. We complemented potential interactions between program and time with the corresponding Bayesian t-tests, to examine the strength of evidence for the alternative vs. null hypotheses. The disadvantage of standard null hypothesis significance testing is that the null hypothesis can be rejected when p values are significantly less than alpha, but non-significant p values cannot be interpreted meaningfully [37]. Thus, a non-significant interaction between program and time in the current mixed model analyses could indicate that the outcomes of the 50-PMP were not in fact superior to outcomes of the 17-PMP. But this could equally be driven by other experimental factors such as lack of power. The Bayesian approach overcomes this limitation of null hypothesis significance testing by allowing researchers to quantify the evidence in favour of the null hypothesis. Using this approach, we were thus able to assess whether any non-significant differences between program outcomes were likely due to non-superiority of the 50-PMP relative to the 17-PMP rather than other experimental factors. When reporting the strength of the evidence for the null hypothesis, BF01, we used the criteria of Lee and Wagenmakers [38]. A Bayes Factor (BF01) of one indicates that the data are equally likely under the null and alternative hypotheses, with BF01 <3 considered anecdotal (and insufficient) evidence in favour of the null. BF01 between 3 and 10 is taken as moderate evidence and >10 as strong evidence (indicative that the data is 10 times more likely in favour of the null than the alternative hypothesis).

## Results

### Baseline characteristics

The two programs were similar at baseline on BMI, oMEDD, medication categories, pain interference and self-efficacy, depression, anxiety, and stress (Table 1). More of the participants in 17-PMP were female. They were also older, reported less pain severity and pain catastrophizing, and were less capable on the physical measures.

| | **Low intensity 17-PMP N=50** | | **Medium intensity 50-PMP N=53** | | |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **Test of significance[2]** |
| Sex | F=43 M=7 | | F=32 M=21 | | $X^2$= 8.53** |
| Age | 56.9 | 12.8 | 51.7 | 13.8 | *t*= -1.975* |
| oMEDD | 37.5 | 64.8 | 55.3 | 73.0 | *U*=1213 |
| Medication categories | 2.7 | 1.4 | 2.3 | 1.7 | $X^2$= 6.04 |
| BMI | 29.1 | 7.0 | 28.4 | 5.9 | *t*= -0.548 |
| Pain Severity (0-10) | 5.3 | 2.0 | 6.2 | 1.4 | *t*= 2.572* |
| Pain Interference (0-10) | 6.1 | 2.2 | 6.6 | 2.1 | *t*= 1.224 |
| Depression (0-42) | 15.7 | 10.9 | 19.2 | 12.5 | *t*= 1.504 |
| Anxiety (0-42) | 12.5 | 8.8 | 15.7 | 12.4 | *t*= 1.485 |
| Stress (0-42) | 18.0 | 11.0 | 21.6 | 11.8 | *t*= 1.634 |
| PSEQ[1] (0-60) | 25.7 | 11.4 | 23.2 | 12.9 | *t*= -1.044 |
| PCS (0-52) | 21.5 | 11.7 | 26.5 | 12.6 | *t*= 2.084* |
| TUG | 9.9 | 3.5 | 8.4 | 2.8 | *U*= 868* |
| 30CST[1] | 7.7 | 2.6 | 11.5 | 4.4 | *t*= 5.188*** |

*p≤0.05; **p≤0.01; ***p≤0.005; oMEDD: oral Morphine Equivalent Daily Dose in milligrams; BMI: Body Mass Index; Pain Severity and Pain Interference are subscales of the BPI: Brief Pain Inventory; Depression, Anxiety and Stress are subscales of the DASS21. PSEQ: Pain Self-Efficacy Questionnaire; PCS: Pain Catastrophizing Scale; TUG: Timed up-and-go; 30CST: 30 second Chair Stand Test. [1]Higher scores are better. [2]*t* = t-test for variables normally distributed, *U* = Mann-Whitney *U*-test for variables not normally distributed, $X^2$ = Chi-squared test for categorical variables.

**Table 1:** Comparison of demographics and outcome measures on admission to low and medium intensity pain management programs.

### Outcomes on self-report measures

Estimated marginal means from the linear mixed models at program start, program end, and 3-month follow-up are shown in Table 2. Statistically and clinically significant differences within programs are shown from program start to end, and from program start to follow-up. Tests of differences between programs are shown, along with tests for the effect of time and the program x time interaction. There was a main effect of time within programs, with clinically significant improvement on most measures either at program end or follow-up, or at both times. There were some differences between programs on the timing of these improvements, but none of the interactions of program x time were significant.

| | | | | | | | | | **Main Effects** | | **Interaction** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Pre** | **Post** | **F/U** | **Pre - Post** | | **Pre – F/U** | | **Group** | **Time** | **Group x Time** |
| **Variable** | **Group** | **Estimated Marginal Means (SD)** | | | **Test[1] of significance and $p^{2*}$** | **Effect size** | **Test[1] of significance and $p^{2*}$** | **Effect size** | **Test[3] of significance and $p^{2*}$** | | |
| oMEDD | 17-PMP | 37.5 (66.3) | 36.9 (62.0) | 39.6 (56.4) | -0.12 | -0.02 | 0.35 | 0.06 | 1.19 | 0.15 | 0.52 |
| | 50-PMP | 55.3 (69.5) | 52.6 (66.4) | 49.6 (62.2) | -0.58 | -0.08 | -1.13 | -0.18 | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BPI Severity | 17-PMP | 5.3 (1.8) | 5.0 (1.7) | 5.1 (1.7) | -1.34 | -0.22 | -0.80 | -0.15 | 3.26 | 5.77** | 1.25 |
| | 50-PMP | 6.2 (1.8) | 5.5 (1.8) | 5.4 (1.7) | -2.99* | -0.44 | -3.25*** | -0.51c | | | |
| BPI Interference | 17-PMP | 6.1 (2.4) | 5.0 (2.2) | 5.2 (2.1) | -3.41*** | -0.56c | -2.60* | -0.48 | 0.40 | 20.98** | 0.60 |
| | 50-PMP | 6.6 (2.3) | 5.1 (2.3) | 5.4 (2.2) | -5.33*** | -0.78c | -4.08*** | -0.65c | | | |
| PSEQ[4] | 17-PMP | 25.7 (13.1) | 31.2 (12.3) | 30.5 (11.8) | 3.13** | 0.51c | 2.47 | 0.46 | 0.32 | 17.06** | 0.36 |
| | 50-PMP | 23.2 (13.1) | 30.5 (12.8) | 29.8 (12.3) | 4.55*** | 0.66c | 3.89*** | 0.62c | | | |
| PCS | 17-PMP | 21.5 (12.3) | 17.3 (11.4) | 15.8 (10.8) | -2.90* | -0.48 | -3.51*** | -0.65c | 1.80 | 27.60*** | 3.29 |
| | 50-PMP | 26.5 (12.3) | 17.4 (11.9) | 19.8 (11.4) | -6.86*** | -1.00c | -4.77*** | -0.75c | | | |
| Depression | 17-PMP | 15.7 (11.3) | 13.4 (10.5) | 12.0 (9.9) | -1.73 | -0.28 | -2.52* | -0.47 | 0.99 | 13.11*** | 2.34 |
| | 50-PMP | 19.2 (11.4) | 13.1 (11.0) | 14.9 (10.5) | -4.94*** | -0.72c | -3.30** | -0.52c | | | |
| Anxiety | 17-PMP | 12.5 (9.9) | 9.8 (9.1) | 8.8 (8.5) | -2.60* | -0.43 | -3.20** | -0.59c | 2.00 | 17.03*** | 0.21 |
| | 50-PMP | 15.7 (9.9) | 12.3 (9.6) | 11.1 (9.1) | -3.63*** | -0.53c | -4.58*** | -0.72c | | | |
| Stress | 17-PMP | 18.0 (11.4) | 15.7 (10.5) | 13.4 (9.8) | -1.79 | -0.29 | -3.23** | -0.60c | 2.94 | 10.26*** | 1.81 |
| | 50-PMP | 21.6 (11.4) | 17.5 (11.0) | 18.8 (10.5) | -3.58*** | -0.52c | -2.33 | -0.37 | | | |
| TUG | 17-PMP | 9.9 (3.2) | 8.7 (2.9) | 8.5 (2.8) | -3.60** | -0.59c | -3.43* | -0.63c | 2.71 | 8.32*** | 2.08 |
| | 50-PMP | 8.4 (3.2) | 8.0 (3.1) | 8.5 (3.3) | -1.14 | -0.16 | -1.38 | -0.22 | | | |
| 30CST[4] | 17-PMP | 7.7 (4.0) | 9.5 (3.6) | 9.5 (3.7) | 3.93*** | 0.65c | 3.23* | 0.60c | 29.06*** | 23.01*** | 0.25 |
| | 50-PMP | 11.5 (4.0) | 13.8 (3.9) | 13.4 (4.1) | 5.07*** | 0.74c | 3.52** | 0.56c | | | |

*p≤0.05; **p≤0.01; ***p≤0.005; [1]*t*-test of significance; [2]Bonferroni adjusted for five comparisons for each outcome variable: Pre-Post 17-PMP, Pre-Post 50-PMP, Pre-F/U 17-PMP, Pre-F/U 50-PMP; Interaction Group X Time. [3]*F*-test of significance; [4]Higher scores are better; cClinically significant change; oMEDD: oral Morphine Equivalent Daily Dose in milligrams; BPI: Brief Pain Inventory; PSEQ: Pain Self-Efficacy Questionnaire; PCS: Pain Catastrophizing Scale; TUG: Timed Up-and-Go; 30CST: 30-second Chair Stand Test; 30CST main effect of group in that 50-PMP were better at all time points than 17-PMP.

**Table 2:** Estimated Marginal Means, SDs and Effect Sizes of outcome variables for the low-intensity 17-PMP and medium-intensity 50-PMP programs from pre to post and pre to follow-up.

Mean oMEDD did not change in either program at any time, nor did the number of medication categories. Mean BPI-Pain Severity scores improved in 50-PMP at program end, but improvement did not reach clinical significance until follow-up. There was no change in 17-PMP at either time. The Bayesian t-test for the null hypothesis (that the 50-PMP was not superior to the 17-PMP) found moderate evidence in favour of the null from program start to end (BF01=8.1) and strong evidence from program start to follow-up (BF01=10.6).

Mean BPI-Pain Interference scores in both programs showed a clinically significant improvement from program start to end. The improvement was maintained at follow-up in 50-PMP but not quite maintained in 17-PMP. The Bayesian t-test found moderate evidence in favour of the null hypothesis from program start to end (BF01=7.6) and from program start to follow-up (BF01=6.6).

Mean Pain Self-Efficacy scores showed clinically significant improvement at program end in both programs, but this was maintained at follow-up in the 50-PMP only. The Bayesian t-test found anecdotal evidence in favour of the null hypothesis from program start to end (BF01=2.8) and from program start to follow-up (BF01=2.7).

Mean Pain Catastrophizing scores in 50-PMP showed clinically significant improvement at program end that was maintained at follow-up. In 17-PMP the improvement was not quite clinically significant at program end, but it was by follow-up. The Bayesian t-test found strong evidence in favour of the null hypothesis from program start to end (BF01=13.5) and moderate evidence from program start to follow-up (BF01=4.7).

Mean Depression scores showed a clinically significant improvement in 50-PMP from program start to end which was maintained at follow-up. In 17-PMP the improvement was small at program end, and not quite clinically significant at follow-up. Despite this, the Bayesian t-test found strong evidence in favour of the null from program start to end (BF01=10.5) and moderate evidence from program start to follow-up (BF01=4.7).

Mean Anxiety scores showed a clinically significant improvement in 50-PMP from program start to end which was maintained at follow-up. In 17-PMP the improvement was not quite clinically significant at program end, but it was by follow-up. The Bayesian t-test found moderate evidence in support of the null hypothesis from program start to end (BF01=5.4) and from program start to follow-up (BF01=6.0).

Mean Stress scores showed clinically significant improvement in 50-PMP by program end that was not maintained at follow-up. In 17-PMP Stress scores did not show clinically significant improvement until follow-up. The Bayesian t-test found moderate evidence in support of the null hypothesis from program start to end (BF01=8.0) but only anecdotal evidence from program start to follow-up (BF01=1.9).

**Functional measures**

Mean scores on the Timed Up-and-Go (TUG) measure showed clinically significant improvement in 17-PMP by program end that was maintained at follow-up. There was no improvement in 50-PMP. Mean scores on the 30-second Chair Stand Test (30CST) showed clinically significant improvement in both 17-PMP and 50-PMP by program end that were maintained at follow-up. The Bayesian t-test on the TUG did not find evidence in favour of the null from program start to end (BF01=0.9) and only anecdotal evidence from program start to follow-up (BF01=1.9). On the 30CST only anecdotal evidence in favour of the null was found from program start to end (BF01=2.3) and program start to follow-up (BF01=1.4). The only main effect of program was on the 30CST, where 50-PMP maintained better scores at all time points.

**Completion rate and characteristics**

Patients who attended the final session of the program and completed the post-program measures were designated completers. As shown in Table 3, program completion was similarly high, 80% in 17-PMP and 89% in 50-PMP. Two-way ANOVAs were used to assess differences on each outcome measure at program start between dropouts and completers. In 17-PMP, there were no differences between dropouts and completers. In 50-PMP, dropouts and completers had reported similar pre-program levels of oMEDD and pain severity, but dropouts reported more severe levels of pain interference, pain catastrophizing, pain self-efficacy, depression, anxiety and stress. The 50-PMP dropouts also reported more severe levels than 17-PMP dropouts in pain catastrophizing, pain self-efficacy, depression, anxiety and stress, but not in pain interference.

| | | | | | | Main Effects | | Interaction |
|---|---|---|---|---|---|---|---|---|
| | | Dropouts | Completers | Dropouts v Completers | Dropouts 17-PMP v 50-PMP | Group | Completion | Group x Completion |
| Variable | Group | Estimated Marginal Means (SD) | | Test[1] of significance and $p^{2*}$ | Test[1] of significance and $p^{2*}$ | Test[3] of significance and $p^{2*}$ | | |
| oMEDD | 17-PMP | 23.8 (69.6) | 41.0 (69.6) | -0.697 | 0.733 | 1.13 | 0.35 | 0.08 |
| | 50-PMP | 50.2 (69.6) | 56.0 (69.9) | -0.193 | | | | |
| BPI Severity | 17-PMP | 5.76 (1.7) | 5.19 (1.7) | 0.919 | 1.129 | 3.95* | 1.59 | 0.01 |
| | 50-PMP | 6.77 (1.7) | 6.11 (1.7) | 0.876 | | | | |
| BPI Interference | 17-PMP | 6.6 (2.1) | 5.9 (2.1) | 0.996 | 1.566 | 3.31 | 5.44* | 1.15 |
| | 50-PMP | 8.3 (2.1) | 6.3 (2.1) | 2.197* | | | | |
| PSEQ[4] | 17-PMP | 23.6 (11.8) | 26.2 (11.8) | -0.618 | -2.262* | 5.24* | 7.12** | 3.56 |
| | 50-PMP | 9.8 (11.8) | 24.9 (11.8) | -2.94*** | | | | |
| PCS | 17-PMP | 21.2 (11.9) | 21.6 (11.9) | -0.089 | 2.735** | 9.26*** | 3.59 | 4.03* |
| | 50-PMP | 38.0 (11.9) | 25.0 (11.9) | 2.517* | | | | |
| Depression | 17-PMP | 15.5 (11.3) | 15.8 (11.3) | -0.067 | 2.931*** | 8.85*** | 5.53* | 5.93* |
| | 50-PMP | 32.7 (11.3) | 17.5 (11.3) | 3.088*** | | | | |
| Anxiety | 17-PMP | 14.4 (10.4) | 12.1 (10.4) | 0.633 | 2.536* | 7.26** | 7.77** | 3.95* |
| | 50-PMP | 28.0 (10.4) | 14.1 (10.4) | 3.081*** | | | | |
| Stress | 17-PMP | 21.8 (10.9) | 17.0 (10.9) | 1.24 | 2.16* | 6.21* | 9.40*** | 2.24 |
| | 50-PMP | 34.0 (10.9) | 20.0 (11.0) | 2.94*** | | | | |
| TUG | 17-PMP | 10.3 (3.5) | 9.8 (3.2) | 0.330 | -0.627 | 1.97 | 0.42 | 0.05 |
| | 50-PMP | 9.1 (3.5) | 8.3 (3.2) | 0.571 | | | | |
| 30CST[4] | 17-PMP | 7.0 (4.1) | 7.8 (3.7) | -0.544 | 1.429 | 9.33*** | 1.15 | 0.15 |
| | 50-PMP | 10.0 (4.0) | 11.63 (3.7) | -0.940 | | | | |

*p≤0.05; **p≤0.01; ***p≤0.005; [1]*t*-test of significance; [2]Bonferroni adjusted for three comparisons for each outcome variable: Dropouts v Completers 17-PMP, Dropouts v Completers 50-PMP, Interaction Group X Completion. [3]*F*-test of significance; [4]Higher scores are better. oMEDD: oral Morphine Equivalent Daily Dose in milligrams; BPI: Brief Pain Inventory; PSEQ: Pain Self-Efficacy Questionnaire; PCS: Pain Catastrophizing Scale; TUG: Timed up-and-go; 30CST: 30-second Chair Stand Test.

**Table 3:** Estimated Marginal Means, SDs for pre-program scores of dropouts and completers in 17-PMP and 50-PMP.

### Ratings of active self-management strategies

Ratings of active self-management strategies by patients in terms of importance and confidence in using them are shown in Table 4. At program end, the retrospective importance ratings ascribed to the strategies at program start ranged from 5/10 to 8/10 in 17-PMP, and from 2/10 to 7/10 in 50-PMP. 17-PMP provided higher pre-program importance ratings than 50-PMP for Meditation, Mindfulness and Sleep Management. On completion, both programs rated most active self-management strategies similarly, as very important (8+/10). 17-PMP rated Sleep Management as more important than did 50-PMP. Both programs reported similar ratings of their confidence in using each strategy, from moderate (7/10) to high (8+/10). The 17-PMP reported higher confidence than 50-PMP in using Meditation and Mindfulness.

| Median ratings of importance of, and confidence in using, active self-management strategies. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Strategy[3]** | **Importance Pre[1a]** | | | **Importance Post[1]** | | | **Confidence Post[1]** | | |
| | **17PMP** | **50PMP** | ***U*[2]** | **17PMP** | **50PMP** | ***U*[2]** | **17PMP** | **50PMP** | ***U*[2]** |
| Pacing | 5.0 | 3.0 | 643 | 10.0 | 10.0 | 731 | 9.0 | 8.0 | 727 |
| Thought management | 6.5 | 5.0 | 628 | 10.0 | 9.5 | 676 | 8.0 | 8.0 | 685 |
| Assertive comm'n | 8.0 | 5.0 | 529* | 10.0 | 9.5 | 706 | 8.0 | 8.0 | 646 |
| Sleep management | 8.0 | 6.0 | 519*** | 10.0 | 9.0 | 597* | 8.0 | 8.0 | 695 |
| Flare-up plan | 5.0 | 2.0 | 546 | 9.5 | 9.0 | 684 | 8.0 | 8.0 | 655 |
| Stretching | 6.5 | 5.0 | 805 | 10.0 | 10.0 | 671 | 9.5 | 9.5 | 793 |
| Strengthening | 7.0 | 7.0 | 807 | 10.0 | 10.0 | 683 | 10.0 | 8.0 | 658 |
| Belly breathing | 6.0 | 5.0 | 679 | 10.0 | 10.0 | 666 | 10.0 | 9.0 | 624 |
| Mindfulness | 7.0 | 2.0 | 519** | 10.0 | 9.0 | 652 | 8.0 | 8.0 | 542* |
| Meditation | 7.0 | 3.0 | 574* | 10.0 | 8.0 | 649 | 9.5 | 8.0 | 557** |
| Desensitisation | 5.0 | 2.0 | 307 | 10.0 | 9.0 | 329 | 8.0 | 7.0 | 343 |

*p≤0.05; **p≤0.01; ***p≤0.005; [1]Instructions were "Please rate the following on a scale from 0 to 10, with 0 the least and 10 the most. Importance of each strategy to you before and after the program – this is your belief that you should do it as you understand the benefits. Confidence is your belief that you know how to do it and can do it NOW." [a]Importance Pre-ratings were provided retrospectively at program end; [2]*Mann-Whitney U*-test of significance; [3]Definitions of active self-management strategies

**Table 4:** Pain Active Self-Management Questionnaire (Pain ASMQ).

**Pacing:** Planning activity to prevent overdoing and avoidance. Stick to baselines by breaking tasks into smaller parts, alternating tasks, taking short breaks.

**Thought management:** Identify unhelpful thoughts that lead you away from your goals. Replace with helpful, realistic thoughts that will lead to better emotional and behavioural outcomes consistent with your goals.

**Assertive communication:** Be assertive and listen well to achieve what you need to manage pain well while enhancing relationships.

**Sleep management:** A routine of a calm evening, set bedtime and wake time. Strategies to manage worry, stress, pain, stimulation, sleep environment. Not relying on medication.

**Flare up plan:** Identify triggers and early warning signs, focus on helpful thoughts and actions to reduce intensity and duration of flare-ups while staying calm and active.

**Stretching:** A type of physical exercise to improve the flexibility and range of motion of muscles and tendons. Done as a full body routine of stretching and holding specific muscle groups with mild to moderate sensation.

**Strengthening:** A type of physical exercise to build strength, endurance and size of skeletal muscles. It uses the resistance of body weight or other weight to make muscles contract. Done as a full body routine with baselines increased slowly.

**Belly-Breathing:** Slow, deep breathing to reduce arousal and tension to manage stress and pain.

**Mindfulness:** Pay attention to the present moment on purpose with acceptance rather than judgement.

**Meditation:** Deliberate practice of mindfulness with focus on breath, body or guided imagery.

**Desensitisation:** Mindfulness with focus on pain to make nervous system less sensitive. Key messages – It is just activity in my nerves, it is not telling me anything new, it is not warning of damage, I do not need to respond in any way.

## Discussion

The main finding of this study is that the medium-intensity group pain management program was not superior to the low-intensity program. Both programs reported clinically significant improvements on most outcomes by the end of the 5-week program or at 3-month follow-up. Pain severity and depression improved in 50-PMP only, though Bayesian testing found evidence of no differences. The Timed Up-and-Go improved in 17-PMP only. Neither program reduced opioid use. Completers in both programs rated the active self-management strategies they had learned to be of high importance, with moderate to high confidence in using them. The education session helped patients make informed decisions about their treatment. Many patients who had previously declined the 50-PMP were open to the 17-PMP, which was so popular among patients with all levels of disability and distress that it effectively replaced the 50-PMP. The study established that better value healthcare was achieved in treating persistent pain in this tertiary-level pain clinic by the addition of the 17-PMP to the stepped-care model. More patients were treated sooner in the clinically effective low-intensity group program using less clinical resources.

However, the new program was attended by fewer men than had attended the 50-PMP. It is possible that men attending the education session got the impression the group PMPs were mainly for women. Perhaps men with persistent pain tend to favour passive pain management strategies or prefer more self-directed learning of the active self-management strategies that are taught in the group PMPs, or are less disposed than females to attending groups generally. Further investigation could determine the reasons for men to decline to participate in the 17-PMP.

Participants in the 17-PMP were older, though the mean age of participants in each program was similar to that of the new patients in the pain clinic at the time. The 17-PMP participants were also less physically capable than those in 50-PMP. The lower intensity PMP may have been more appealing to older patients who were less physically capable. Some of the participants in 17-PMP were very limited in their physical capacity, with more using mobility aids than those in 50-PMP. Further investigation could determine whether the age of patients is associated with a preference for lower or higher intensity PMPs. However, in a stepped-care model, a patient of any age could conceivably select the intensity that suits them best at the time.

Regarding medication use, neither program had any impact either during the program or by the 3-month follow-up. Patients were not tracked beyond the 3-month follow-up to see whether any changes occurred. Often patients would state at the end of a program that they expected to reduce medications once they had established routine use of active self-management strategies. High intensity PMPs often ask patients to reduce pain-related medications before participating [19]. The attending clinicians in this pain service typically encourage patients to reduce medications after they have learned some active self-management strategies. The Pain Active Self-Management Questionnaire did not include an item about pain-medication reduction when completed by the 50-PMP participants. In 17-PMP, though, the median importance of pain-medication reduction increased from a rating of 7/10 to 10/10 during the program, and participants reported a median confidence in reducing pain medications of 9.5/10. It will be an ongoing challenge to integrate medication reduction in future iterations of any PMP.

The main hope for all patients attending a pain service is reducing both the severity of pain and the interference caused by pain. In 50-PMP, mean pain severity improved by follow-up, while remaining in the moderate severity range. Mean pain interference also improved by program end and at follow-up. In contrast, no improvement in pain severity was reported in 17-PMP. It remained in the lower end of the moderate severity range, numerically lower than those in 50-PMP at each time point, so there may be a floor effect that allowed little improvement overall. Despite this, pain interference scores in 17-PMP showed clinically significant improvement at program end.

Perhaps most interesting is the observable improvement in functional capacity. Both programs improved on the 30-second

Chair Stand Test, with 50-PMP more capable at all time points. This exercise is a feature of the exercise routine in both programs. Performance on the Timed Up-and-Go only improved in 17-PMP and achieved the same level as 50-PMP at follow-up. Given the 50-PMP had far more supervised exercise within the two sessions each week, including cardiovascular exercise, this finding endorses the value of the between-sessions exercise prescription in 17-PMP.

This is the first time the Pain ASMQ has been used to compare groups. It has good face validity, being directly related to the content of the PMPs. Its construct validity was demonstrated by the higher importance ratings ascribed to some strategies by patients in 17-PMP, who had attended the education session before starting their PMP. An item about medication reduction was included in the Pain ASMQ for 17-PMP. The authors have since included a rating by patients of their commitment to use each strategy. Further assessment of the validity and reliability of the Pain ASMQ will include examination of the correlation of ratings with outcomes, the correlation of ratings at program end and follow-up. The addition of items measuring adherence to practice of active self-management strategies between sessions could be considered, as adherence has been found to predict improvement among patients in pain programs [39].

Recruitment to any PMP should assist the patient to gain a thorough understanding of the commitment involved. Program completion was high in both programs, at 80% for 17-PMP and 89% for 50-PMP. This reflects a commitment by patients to attendance at sessions. Most patients withdrawing from the 17-PMP for related cause did so after the first session and stated that the program was more involved than they had expected, and they would prefer individual treatment sessions. Most patients withdrawing from the 50-PMP for related cause did so after several sessions and stated that they were finding the full day attendance too demanding. These patients may have completed a lower-intensity program if given the opportunity.

### Strengths

Clinical consistency was assured as the same psychologist and physiotherapist, who are experienced, facilitated all programs. Patients were supported with the same patient manual, though the workbook for 17-PMP had modifications to account for fewer activities. Both programs were conducted over a 5-week timeframe.

The sequential allocation of patients to the 50-PMP and then 17-PMP reflects the reality of service provision, where random allocation to treatments may not be possible when quality improvements are being considered. The sequential allocation did introduce some between-program variability in terms of sex, age, pain severity, pain catastrophizing and functional measures. Otherwise, the characteristics of the patients in the two programs were quite similar. The use of the linear mixed model helped to account for this variability. The high completion rates in the programs helped to retain a good level of statistical power for the number of tests conducted.

### Limitations

The authors may be biased in favour of the 17-PMP. They certainly wanted it to be effective, as its introduction had largely solved their waiting list problems. The self-report measures used in this project are widely used and well-regarded. However, they are less objective than observable performances. Patient evaluations of the programs were not compared numerically. Patients were generally well-satisfied by the format of the programs they attended, though more of those in the 50-PMP commented that the program was too intense, and more of those in 17-PMP commented that the program could be extended by a few weeks. The lack of male patients, especially in the 17-PMP, may limit generalisability of these results beyond females. The patients included in these results were literate in English. Results of this project may not generalise to speakers of other languages, though good outcomes have been reported in cross-cultural offerings of a PMP [40]. The time between a patient's attendance at the education session and the start of the 17-PMP introduced a variable that was not controlled. Some patients had time to start implementing pacing and mindfulness while waiting for the program, while others started the program almost immediately.

### Conclusion

The revised stepped-care model including the 17-PMP achieved better value healthcare. The model improved patient access to group and individual treatments by using clinical resources more efficiently. The 17-PMP was applicable to patients with all levels of disability and distress, and similar in effectiveness to the 50-PMP. Revision of the 17-PMP recruitment processes, content and timeframe may lead to more participation by men and better outcomes, especially for medication use.

### Acknowledgements

The 17-PMP was adapted from the Brief Pain Self-Management Program developed by the Pain Management Research Institute at Royal North Shore Hospital in Sydney. The primary outcome measures are provided by the Australasian electronic Persistent Pain Outcomes Collaboration (ePPOC) based at the University of Wollongong.

### Author Contributions

All authors made substantial contributions to either conception and design, acquisition of data, or analysis and interpretation of data. All authors contributed to drafting the article or revising it critically for important intellectual content. All authors provided

approval of the version to be published. TH takes responsibility for the integrity of the work as a whole, from inception to published article.

**Data availability:** The data that support the findings of this study are available from the corresponding author, [TH], upon reasonable request.

**Ethic approval:** The study was approved by the South Eastern Sydney Local Health District Research Office as a quality assurance and improvement project not requiring participant consent.

**Clinical trial registration:** Not applicable

**Reprints available:** Tony Hollins

**Author Contributions**

Tony Hollins: Substantial contribution to the study conception, study design, data acquisition, data analysis and interpretation of the data; drafting and revising the manuscript critically for important intellectual content; final approval of the manuscript.

Skye Sadokierski: Substantial contribution to the study conception, study design, data acquisition; drafting and revising the manuscript critically for important intellectual content; final approval of the manuscript.

David Begley: Substantial contribution to the study conception, study design, data acquisition; drafting and revising the manuscript critically for important intellectual content; final approval of the manuscript.

KokEng Khor: Substantial contribution to the study conception, study design; drafting and revising the manuscript critically for important intellectual content; final approval of the manuscript.

Poppy Watson: Substantial contribution to data analysis and interpretation of the data; drafting and revising the manuscript critically for important intellectual content; final approval of the manuscript.

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