ORIGINAL RESEARCH

# Buy-In for Back Pain: Does Individualization Matter?

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## ABSTRACT

**Background:** The aim of this study was to investigate the effect of individualization of an exercise program on the buy-in received from chronic low back pain (CLBP) patients.

**Methods:** Participants were randomized to 8 weeks of an individualized (IEP) or general exercise program (GEP). All participants were required to attend one 1:1 session per week with an exercise physiologist and 4 home-based sessions. Clinical outcomes were assessed with the Oswestry Disability Index (ODI) and visual analog pain scale (VAS) measured before and after the 8-week intervention along with barrier self-efficacy and adherence. Additionally, multidimensional outcome expectations, exercise self-efficacy, and intention to exercise were measured before the intervention, after the first session, and after 8 weeks. Measures were taken after the first session to observe if clinical assessment and informing the patient that the program was individualized manipulated beliefs differently compared to providing a GEP. Beliefs about the program after the first session were elevated in both groups.

**Results:** Adherence to the supervised and home-based sessions was high and similar between groups. Clinical outcome measures were similar with both groups showing significant reduction from baseline in the ODI ($P \leq 0.01$).

**Conclusion:** Thus, it appears an individualized program is no more beneficial than a GEP for CLBP. Clinically, it appears a GEP is an intelligent choice for practitioners as it negates the need for clinical assessments, which appear to add no benefit to outcomes or adherence. *Journal of Clinical Exercise Physiology.* 2018;7(4):82–93.


**Keywords:** adherence, social cognitive theory, chronic pain

## INTRODUCTION

Low back pain is the greatest worldwide physical burden as measured in terms of disability-adjusted life years or years lived with disability (1). While exercise is a first-choice recommendation for chronic low back pain (CLBP) (2), programming options confronting practitioners are numerous and confusing. In Australia, accredited exercise physiologists (AEPs) are health professionals specializing in the management of chronic conditions such as CLBP (3). Among AEPs, there is a common perception that CLBP is indicative of structural or performance-based insult. This is reflected by current practice involving patient assessment for faulty movement patterns and aspects of muscular function for the purpose of individualizing an exercise prescription. Interestingly, there is debate among practitioners and researchers about both the components of and need for exercise individualization in patients with CLBP (4). Research suggests that a general exercise prescription where all CLBP patients are prescribed the same program appears to achieve similar clinical and physical outcomes to individualized prescription (5,6). While individualization of an exercise program may not be superior to a general exercise prescription based on structural or performance changes, there is a lack of understanding regarding if the beliefs of the patient are affected differently by these 2 modalities. It is plausible that the information provided to patients regarding individualization of an exercise program may enhance buy-in, leading to increased adherence.

Adherence is a key determinant of short- and long-term outcomes from exercise interventions for CLBP (5). Of

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concern, it has been reported that between 50 to 70% of CLBP patients are not adherent to an exercise program (7–9). With no clear indication of the efficacy of any one particular exercise modality, the ability of an exercise prescription to gain adherence becomes a pragmatic goal for practitioners. It has been reported that patients prefer to be informed that a program is individualized because of the feeling that the program is achievable and designed for their rehabilitation (10). Furthermore, patients desire an accurate diagnosis (10), which may suggest that an individualized clinical assessment to inform exercise program design will have a positive influence on beliefs. However, demonstration of exercise and subsequent feedback on movement also had a positive influence on patient outcome expectations and adherence (10). Indeed, both general (GEP) and individualized exercise programs (IEPs) involve the practitioner teaching and critiquing patient exercise, although the timeline of this delineates between approaches. The initial session of a GEP typically involves demonstration of the exercises used in the program, with supervised feedback of the performance of the client. Conversely, the first consultation of an individualized prescription does not often involve exercise, but rather an array of assessments to inform the prescription, which is usually presented in the subsequent session. Therefore, based on reports of CLBP patients' preferences for exercise prescriptions (10), both modalities have the potential to positively manipulate patient beliefs associated with adherence and the success of the program.

Social cognitive theory (11) provides a framework to understand adherence to an exercise program. According to social cognitive theory, self-efficacy, outcome expectations, and intention are determinants of patient behavior (i.e. adherence to an exercise program) (11). Self-efficacy refers to an individual's belief in their ability to accomplish a given task and is therefore a component of the patient's belief in their ability to perform and adhere to an exercise program. Outcome expectations are the patient's beliefs about what the exercise program will help him or her to achieve. Intention refers to the patient's foresight of compliance to the exercise program (including both supervised and unsupervised sessions). Social cognitive theory (11) has been successfully used to understand physical activity behavior (12) and thus provides insight to beliefs associated with adherence. Current exercise interventions for CLBP have not considered the pathways proposed by social cognitive theory (11). It is unknown whether the information provided during an individualized exercise prescription will manipulate the pathways of social cognitive theory differently when compared to a general exercise prescription. This understanding will inform exercise-based practitioners of the efficacy of these modes of exercise at manipulating beliefs associated with adherence.

We conducted an 8-week pilot randomized controlled trial to observe any key differences in outcomes, adherence, and patient buy-in to either an IEP or GEP for CLBP patients. Our primary objectives were (1) to examine changes in patients' beliefs associated with adherence after an initial session based around an individualized or general prescription, (2) to measure patient clinical outcomes, adherence, and beliefs after 8 weeks of either an individualized or general program, and (3) to provide feasibility considerations for an adequately powered study. The results of this research will be used to inform exercise-based practitioners of the need for clinical assessment and individualization to achieve CLBP patient buy-in.

## METHODS

This was a single-center, double-blind, randomized controlled trial conducted in Sydney, Australia, following the principles of the Declaration of Helsinki (13) and in accordance with Australia's National Statement on Ethical Conduct in Human Research (CONSORT) (14) (Figure 1). Participants provided informed written consent prior to commencing the baseline assessment. This study received ethical approval from the local institution and was registered at the Australian New Zealand Clinical Trials Registry (ACTRN12613000037707).

Based on pilot study recommendations (15), we recruited 30 participants with CLBP (Figure 1, Table 1). Participants were recruited from the community via newspaper advertising, letterbox leaflets, and word of mouth. In all methods used for participant recruitment, only the most important inclusion and exclusion criteria were presented in a simplified form to limit the response to those most suitable for participation (Table 2). To reduce expectation bias, participants were blinded to the use of different exercise programs in the trial. Participants were informed that they were volunteering for a study to investigate how exercise programs work for people with CLBP.

Participants were randomly assigned to either an IEP or a GEP. The IEP group received an individualized exercise prescription based on clinical assessment (Appendix 1), consistent with the scope and practice of an AEP within Australia. Conversely, the GEP group were all provided the same exercise program based on common exercises observed in the literature and clinical practice. Both groups' exercise prescription was for 8 weeks. Self-report forms to assess pain and disability were collected at baseline and at 8 weeks. Self-report forms measuring barrier self-efficacy and beliefs associated with adherence were collected at baseline, immediately after the first session, and after 8 weeks. All participants were required to attend 1 supervised session per week and were provided 4 unsupervised home-based sessions to complete. Adherence to unsupervised sessions was monitored through training diaries and checked each week during the supervised session.

Randomization was conducted by a researcher with no involvement in the assessment protocols or training programs. Participants were randomly assigned in blocks of 6 with an equal number of participants (n = 3) assigned to each group. The allocation sequence was concealed from researchers involved in enrolling and assessing participants. Once a research assistant had allocated the participants to a particular group, contact information was provided to the instructor to arrange session time.

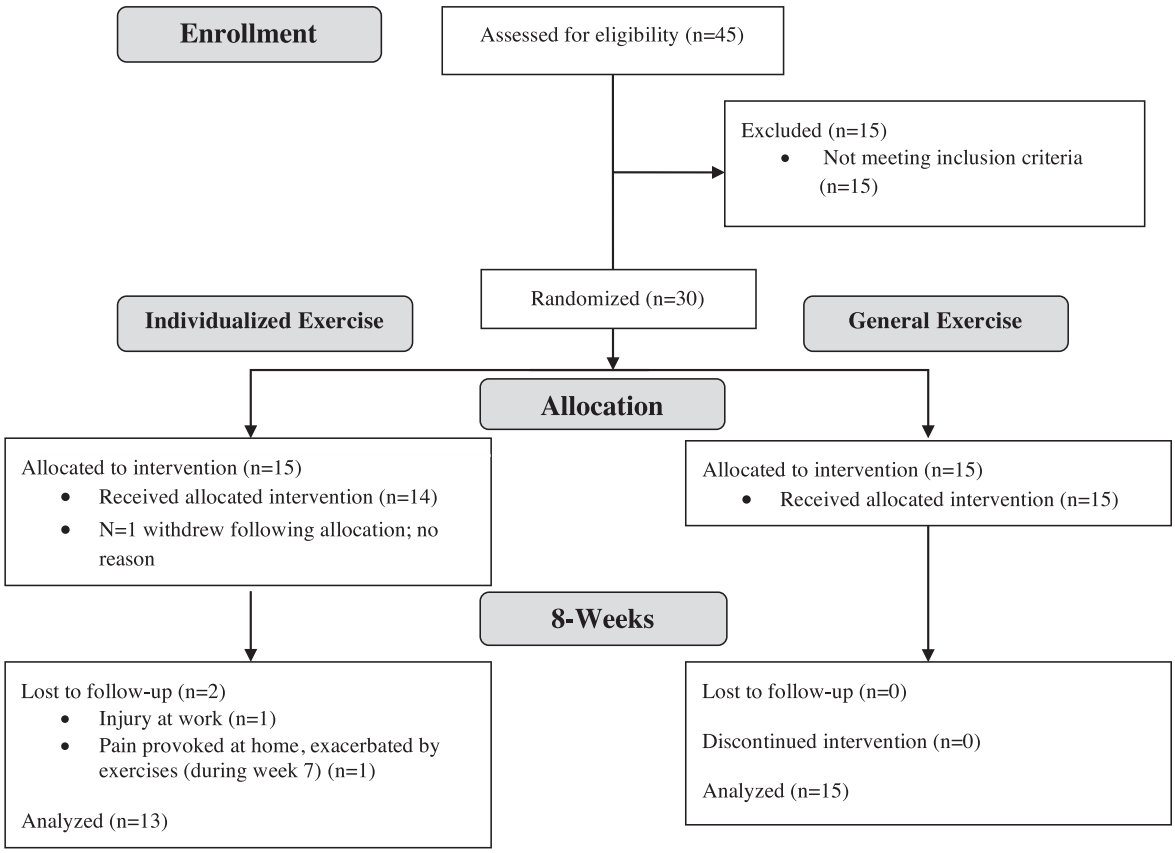


FIGURE 1. Consolidated Standards of Reporting Trials consort flow diagram.

Six exercise instructors were randomly assigned to either the IEP or GEP and were blinded to the intent of the study. All instructors had more than 3 years of experience as personal trainers, and each had an undergraduate exercise physiology degree. Instructors were trained in the exercise intervention they were assigned to, which occurred in supervised classes taking place over a 3-month period. The design of both exercise programs and training of all instructors (but no participant training) was performed by a research investigator with over 15 years of experience as a clinical exercise physiologist and a PhD in exercise rehabilitation for CLBP.

All participants were required to attend 1 supervised session per week at the university training center for a total of 8 weeks and were programmed 4 home-based sessions per week. Training diaries were provided to all participants that described their program and provided instructions for how to record their exercise sessions (e.g. Appendix 1). Participants were required to record all exercise sessions performed that were separate to the prescribed program. Training diaries were checked every week at the supervised session. Every supervised exercise session was approximately 60 min in duration and was supervised on a 1:1 basis. Groups were trained in separate rooms to minimize contact between participants.

The IEP involved an initial clinical assessment performed within the first training session to determine program design. The assessment was designed within the context of the scope of practice for a clinical exercise physiologist in Australia (www.essa.org.au). Individualization was based on findings examining low back pain reporting during prolonged postural tasks (16–18), restricted hip range of motion and flexibility programming (19,20), reduced muscular endurance (21–23), pain centralization and direction-specific training (24), and observation of aberrant lumbar spine and hip movement patterns requiring stabilization exercises and corrective instruction (i.e. hip hinge movement strategy, appropriate positioning of hip and knees during squats) (25,26). Each exercise prescription was tailored to the participant based on the observations from the clinical assessment. The instructor provided an initial IEP for the first week's home-based training at the end of this session. The participants were informed about the rationale for the initial exercises based on the findings of the completed assessment. Thus, it

TABLE 1. Demographic data of study participants.

| Variables | IEP (n = 13) | GEP (n = 15) |
|---|---|---|
| Age (y) | 38.8 ± 7.6 | 36.6 ± 7.2 |
| Height (m) | 1.68 ± 0.06 | 1.70 ± 0.09 |
| Weight (kg) | 79.1 ± 10.4 | 82.1 ± 21.9 |
| Gender (% male) | 43 | 40 |
| Duration of symptoms (y) | 15.4 ± 10.4 | 10.4 ± 4.3 |

IEP = individualized exercise program; GEP = general exercise program

TABLE 2. Participant eligibility criteria.

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Men and women between 18–50 y | Pregnancy |
| People with chronic (>3 mo) or recurrent (>3 episodes in previous 12 mo that required treatment, pain relief, missed training session or day of work) nonspecific low back pain of mechanical origin with pain located between the costal margins and above the inferior gluteal folds | Persistent pain symptoms radiating below the knee |
| | Known history of or currently symptomatic lumbar disc hernia or fracture |
| | Diagnosed inflammatory joint disease |
| No lifetime history of spinal surgery | Severe osteoporosis |
| Access to telephone and e-mail for program support | Known metabolic or neuromuscular disease |
| People willing to attend 8 weeks of supervised exercise in addition to home-based exercise | Red flags indicating serious pathology (e.g. cancer, cauda equina lesion) |
| Fluency in English (verbal and written) | Postural abnormality contributing to the diagnosis |
| | Recent (<3 mo) participation in an exercise program or any form of physical treatment (i.e. manipulation, mobilization, massage) |
| | Acute (<6 wk) or subacute low back pain (6–12 wk) with <2 other similar episodes during the previous 12 mo |

was ensured all patients were provided information regarding the program being individualized for them, based on the findings of the clinical assessment. Subsequently, the IEP instructor(s) and the lead researcher met to prescribe the IEP based on the assessment findings. The instructors were provided the ability to modify the intensity at any point throughout the 8 weeks based on recommendations and evidence for the intensity of exercise progressions in CLPB patients (27–29). Instructors for the IEP were also allowed to modify exercise technique based on symptom provocation. This ongoing modification reiterated the information to the patient regarding the individualized nature of the prescription. Exercise progression templates are provided in Appendix 2.

The GEP involved a standard range of exercises (Appendix 3) commonly observed in clinical practice and research literature for CLBP rehabilitation (6,29–33) that were given to all participants in the group (i.e. all participants in the GEP group received the same prescription). The initial session consisted of a standard routine of these exercises. The program was divided into two 4-week phases, where the second phase increased the difficulty of exercises for all individuals in the GEP group. All exercises were the same for all patients, apart from push-ups where females were able to pivot from their knees. Instructors were not allowed to individualize progressions within any exercise. No exercise was allowed to be modified based on symptom provocation (only removed from the program).

At the baseline assessment, age, gender, height (m), weight (kg), and duration of symptoms (years) were recorded. Self-report questionnaires were completed by participants at baseline (full-set) (Table 3), at the end of the first exercise session (all except the VAS pain scale and ODI), and at the end of the 8-week intervention (full-set). At the 8-week assessment, success of blinding was examined by asking participants if they could describe what the study was about.

The Oswestry Low Back Pain Disability Index (ODI) was used to measure disability (34). The ODI is a 10-item questionnaire examining how a patient's low back pain affects different activities during their life (0–100% scoring, 0% = no disability). Two separate 10-cm VAS pain scales (35) with *no pain* on the left side and *worst pain* on the right side were used to measure current pain intensity, and worst pain recalled during the last week (36,37).

Outcome expectations were measured with the Multidimensional Outcome Expectations for Exercise Scale (12), a 15-item scale with 6 items reflecting physical outcome expectations (POE) (38), 4 items assessing social outcome expectations (SOE) (38), and 5 items measuring self-evaluative outcome expectations (SEOE) (38). Participants were asked to rate how strongly they agreed with each of these 15 items on

TABLE 3. Baseline data for outcome measures.

| | IEP (Mean, SD) | GEP (Mean, SD) |
|---|---|---|
| ODI (0–100%) | 18.2 ± 5.6 | 21.1 ± 8.4 |
| Pain VAS (1–10 cm) | | |
| Current | 2.5 ± 2.0 | 2.4 ± 1.6 |
| Last week | 4.8 ± 2.9 | 5.4 ± 2.0 |
| BSE (0–100%) | 68.0 ± 14.2 | 75.4 ± 11.3 |
| POE (0–30) | 22.6 ± 4.0 | 23.1 ± 2.9 |
| SOE (0–20) | 11.5 ± 3.9 | 10.1 ± 3.7 |
| SEOE (0–25) | 17.8 ± 3.1 | 17.6 ± 3.6 |
| ESE (0–100%) | 83.8 ± 17.0 | 80.3 ± 20.3 |
| INT (0–4) | 3.1 ± 0.6 | 3.2 ± 0.9 |

IEP = individualized exercise program; GEP = general exercise program; ODI = Oswestry Disability Index; VAS = visual analog scale; BSE = barrier self-efficacy; POE = physical outcome expectations; SOE = social outcome expectations; SEOE = self-evaluative outcome expectations; ESE = exercise self-efficacy; INT = intention

TABLE 4. Change and between-groups differences in clinical outcome measures after the 8-week intervention.

| | IEP (Mean, 95% CI) | GEP (Mean, 95% CI) | Group Differences (Mean 95% CI) |
|---|---|---|---|
| ODI (0–100%) | −8.0 (−11.4 to −4.5)* | −4.5 (−7.8 to −1.3)* | 3.4 (−1.4 to 8.3)[a] |
| Pain VAS (1–10 cm) | | | |
| Current | −0.5 (−1.2 to 0.3) | −0.7 (−1.3 to 0)* | 0.2 (−0.8 to 1.2) |
| Last week | −1.3 (−2.7 to 0.1) | −0.8 (−2.1 to 0.5) | 0.6 (−1.4 to 2.5)[b] |

CI = confidence interval; ODI = Oswestry Disability Index; VAS = visual analog scale
*$P < 0.05$ from baseline
[a]Moderate effect between-groups difference ($\eta^2$)
[b]Small effect between-groups difference ($\eta^2$)

a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*), with a higher score indicative of positive expectation.

The self-efficacy for exercise scale ($\alpha = 0.92$) (39) was adapted from previous research (32,40,41) and measured by presentation of 2 stick figure drawings of exercise techniques that would be performed by all participants during their first exercise session (quadruped and split squat exercises). Patients were asked on a 0 (*cannot do at all*) to 100% (*highly certain I can do*) scale how certain they were that they could perform the exercise. The average of both scores was used to score the patient's exercise self-efficacy (39).

Barrier self-efficacy (BSE) (11) ($\alpha = 0.95$) (42) was assessed with an 18-item questionnaire that asked how confident the participant was that he/she could regularly perform his/her program in certain situations (e.g. "when I am feeling tired," "when I am feeling depressed"). Each item was rated from 0 (*cannot do at all*) to 100% (*highly certain I can do*), and the average score of the 18 items was calculated to score the patient's BSE. Intention to exercise was measured by asking participants to self-rate how many exercise sessions they intended to perform at home during the next 4 weeks (0–4 sessions).

### Statistical Analyses

To examine between-groups differences, an analysis of covariance (ANCOVA) was performed for all measures, with change (postscore/first session score − baseline) as the dependent variable and the baseline measure as the covariate. Between-groups differences were than analyzed using effect sizes ($\eta^2 = 0.01$–$0.058$ small effect, 0.059–0.137 moderate effect, >0.138 large effect). Clinically meaningful indicators (CMIs) for reductions were then calculated for the primary clinical outcomes. Clinically meaningful indicators were determined by a greater than 10-point reduction on the ODI and 30% or greater reduction on the VAS scales (43). Subsequently, power calculations were performed using calculated effect sizes to estimate sample sizes for an appropriately powered study ($1 - \beta = 0.80$) (44). Statistical significance was set to $P \leq 0.05$.

## RESULTS

Forty-five patients were required to be screened to recruit 30 eligible participants (75%). The recruitment rate averaged 6 enrollments per month (range = 2–10). Twenty-eight participants (93%) received their allocated intervention and completed the 8-week assessment. Only 4 participants who had existing personal relationships with comparison group participants (n = 2 within family, n = 2 friends) were aware of the study design. The data from these participants were included in the analysis as outcomes were consistent with the mean change for all measures. No adverse events were reported within the programs, although 1 participant in the IEP withdrew from the study when symptoms provoked at work were exacerbated by exercise.

### Clinical Outcomes

After 8 weeks, the ODI showed a moderate effect size for between-groups difference favoring the IEP ($\eta^2 = 0.08$) (Table 4), and CMI were reported for 31% of participants in the IEP and 27% in the GEP. Visual analog scale last week showed a small effect size for between-groups differences ($\eta^2 = 0.01$), while VAS current showed no between-groups differences (Table 4). Clinically meaningful indicators were recorded for 31% of the IEP and 53% of the GEP in VAS last week, and 46 and 47% in VAS current, respectively. Current VAS showed a significant reduction from baseline in the GEP group only ($P = 0.01$).

### Behavioral Outcomes

#### *First Session*

All changes after the first session followed a trend to favor the GEP group. Moderate increases were observed in SEOE following the first exercise session in the IEP group ($P = 0.03$, Table 5). Moderate to strong increases in POE ($P = 0.01$), SOE ($P = 0.02$), and SEOE ($P = 0.06$) were observed for the GEP group (Table 5). Between-groups differences for the increased POE, SOE, ESE, and intention scores were small.

#### *8 Weeks*

A decrease was observed for BSE in the GEP group ($P = 0.004$), with a small to moderate effect size for the between-groups difference in BSE changes after 8 weeks ($\eta^2 = 0.57$, Table 5). A significant decrease was observed for intervention in the GEP group (P = 0.01) with a small between-group difference ($\eta^2 = 0.02$, Table 5). A small effect was observed for compliance, favoring the IEP group (Table 5).

TABLE 5. Change and between-groups difference in secondary outcome measures and compliance after the first session and 8 weeks.

| | IEP (Mean, 95% CI) | GEP (Mean, 95% CI) | Group Differences (Mean 95% CI) |
|---|---|---|---|
| First session | | | |
| POE (0–30) | 1 (−0.6 to 2.6) | 2.2 (0.7 to 3.8)* | 1.2 (−1 to 3.4)[b] |
| SOE (0–20) | 0.7 (−0.2 to 1.6) | 1.3 (0.5 to 2.1)* | 0.6 (−0.6 to 1.8)[b] |
| SEOE (0–25) | 1.3 (0 to 2.7)* | 1.4 (0.2 to 2.7)* | 0.1 (−1.8 to 1.9) |
| ESE (0–100%) | −0.9 (−7.9 to 6) | 2.8 (−3.7 to 9.2) | 3.7 (−5.8 to 13.3)[b] |
| INT (0–4) | 3.0 (2.6 to 3.3) | 3.2 (2.9 to 3.6) | 0.3 (−0.2 to 0.8)[b] |
| 8 wk | | | |
| POE (0–30) | −0.4 (−1.9 to 1.2) | 0.9 (−0.6 to 2.3) | 1.2 (−0.9 to 3.4)[b] |
| SOE (0–20) | 0.4 (−0.9 to 1.8) | 1.1 (−0.2 to 2.4) | 0.7 (−1.2 to 2.6)[b] |
| SEOE (0–25) | 1.3 (−3.4 to 0.7) | 0.8 (−1 to 2.8) | 2.2 (−0.7 to 5)[a] |
| ESE (0–100%) | 10.4 (4.2 to 16.5)* | 5.4 (−0.3 to 11.1) | 5 (−3.4 to 13.4)[b] |
| INT (0–4) | 2.6 (2.1 to 3.1) | 2.4 (1.9 to 2.9)* | 0.2 (−0.5 to 0.9)[b] |
| Comp (0–4) | 3 (2.4 to 3.6) | 2.8 (2.2 to 3.4) | 0.2 (−0.7 to 1.1)[b] |
| BSE (0–100%) | −7.2 (−16.5 to 2.1) | −11.4 (−20 to −2.8)* | 4.2 (−8.8 to 17.1)[b] |

CI = confidence interval; IEP = individualized exercise program; GEP = general exercise program; ODI = Oswestry Disability Index; VAS = visual analog scale; POE = physical outcome expectations; SOE = social outcome expectations; SEOE = self-evaluative outcome expectations; ESE = exercise self-efficacy; INT = intention; Comp = compliance; BSE = barrier self-efficacy

*$P < 0.05$ from baseline

[a]Moderate effect between-groups difference ($\eta^2$)

[b]Small effect between-groups difference ($\eta^2$)

### *Adherence*

Attendance across the 8 weeks at supervised sessions was 7.1 ± 0.8 and 6.9 ± 0.9 for the IEP and GEP groups, respectively. Adherence to the home-based sessions was 3.0 ± 1.1 and 2.8 ± 1.1. No significant between-groups difference was found for adherence to the practitioner-led sessions or the home-based sessions.

## DISCUSSION

The results of this study confirmed that both the IEP and GEP are feasible for people with mild to moderate levels of CLBP. Therefore, confusion and debate among personal trainers and clinical exercise physiologists concerning the structure of exercise prescription for CLBP may be unnecessary. Both programs had high retention rates, maintained adequate levels of adherence, and had similar numbers of participants reporting CMI. This study suggests that individualization of CLBP exercise prescription holds no significant advantage over a GEP for outcomes, buy-in, or adherence.

After an initial exercise session, CLBP patients in both groups reported improved beliefs about the program, which has been identified as increasing adherence and achieving positive outcomes (10,12). Indeed, between-groups differences were observed favoring the GEP after the initial session. However, this study was underpowered to report significance. One key difference between the initial session for the 2 groups was the use of an exercise routine for the GEP as compared to the IEP's clinical assessment. With no difference being observed in outcomes or beliefs, it appears time involved in performing clinical assessments may be better used to teach movement competency for the purpose of prescribing home-based exercise. Furthermore, in the context of AEPs in Australia, public health schemes provide CLBP patients with only 5 AEP sessions. Thus, using 1 of 5 sessions for the purpose of clinical assessment, which appears to hold no benefit on outcomes, adherence, or beliefs associated over prescribing exercise, appears redundant.

Indeed, similar exercises were used between groups in this study. However, this does not impact the information provided about the rationale of an exercise program, which is believed to manipulate beliefs and gain patient buy-in. It is plausible that informing patients in the GEP group that the exercise program was designed for CLBP is responsible for the similar response in beliefs associated with adherence, which has previously been reported (10). Based on this understanding, it appears intelligent for practitioners to inform patients the program is designed for CLBP, which will achieve the same beliefs as individualization without the need for time-consuming clinical assessment.

A limitation of this study is the lack of an objective physiological measure to observe differences of the prescriptions beyond patient beliefs. One measure proposed for CLBP research is the nociceptive withdrawal reflex (NWR) (45). The NWR is an indirect estimate of central sensitization that has been applied to CLBP populations (45). However, evidence suggests that changes in physiological

measures such as lumbar fatigability and postural control may not discriminate between different types of exercise programs where similar reductions in pain and disability are observed (5,19,32,46–48). Furthermore, there is a lack of evidence concerning a relationship between changes in physical/performance measures and clinical outcomes after an exercise intervention (49). Therefore, while the addition of an objective measure may have provided insight to potential differences in how individualized and general programs effect physiological measures, it appears this information may not be relevant.

This research was designed as a pilot randomized controlled trial and was underpowered to report a statistically significant difference between groups for the change in ODI score, with a moderate between-groups effect size ($\eta^2$ = 0.08). To determine the amount of participants needed for an adequately powered study post hoc, power calculations were performed based upon the absolute between-groups differences for ODI. The results showed that an adequately powered study to determine between-groups differences would require a total of 172 participants. To account for eligibility of participants (75%) and dropout rate (7%), 230 participants would have to be recruited, which would take 38.3 months based on the recruitment rate of this study. Although a larger trial may report statistical significance, this does not appear to be clinically meaningful due to the absolute between-groups difference for the ODI not exceeding 5 points (3.4, Table 4) (50). Furthermore, both groups displayed a similar number of patients reporting clinically meaningful indicators for the ODI and pain measures (ODI = 31% IEP, 27% GEP; VAS-c = 31% IEP, 53% GEP, VAS-w = 46% IEP, 47% GEP). Therefore, based on the lack of clinically meaningful difference between groups, conducting an adequately powered study to investigate statistical significance appears redundant and would require considerable time and resources.

## CLINICAL IMPLICATIONS

The results of this study suggest there is no difference in buy-in from CLBP patients based on providing information regarding an individualized exercise prescription as compared to a GEP. Furthermore, a trend was observed for an earlier introduction to exercise to positively influence patient beliefs, particularly for exercise self-efficacy. The use of clinical assessments to provide patients with an individualized prescription demonstrated no benefit to prescribing and teaching exercise. Indeed, it is plausible that similar beliefs between groups were observed as the general exercise program group were informed their program was for CLBP. Thus, it appears an intelligent choice for practitioners to introduce patients to the exercises in their program while informing them it is designed for CLBP, which negates the need for using the initial session for the purpose of clinical assessment that will not provide any benefit to outcomes or buy-in.

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## APPENDIX 1

### YOUR EXERCISE PROGRAM ☺

Your exercise program has ***been individualized for you*** based on the assessment performed by your exercise supervisor.

**How Has Your Program Been Designed?**

What you will see on the following page are the links between the assessment performed with you and the type of exercise we are going to use to help address your back pain.

We are going to provide you with a program that is specific for you, rather than providing a "cookie cutter" program that could be given to all back pain patients.

**What Would We Like You to Do?**

We would like you to perform 5 exercise sessions per week (including sessions that are supervised at the university), based on the exercise program ***specifically designed for you***.

*We would like you to use this training diary as a way of recording all of your exercise sessions (date, location, brief overview of exercises you performed)*.

Please let us know at any time if there is anything we can do to help you with your exercises, including:

- Changing the exercises,
- Using other types of exercise,
- Changing a technique if you are uncomfortable.

**What Do We Expect to Achieve with Your 8-Week Exercise Program?**

- Start to improve your back pain
- Help improve movements and activities in your daily life
- Help you feel better about your ability to manage your back pain

Most important for us is that we help improve your overall functioning in all the different parts of your life and that we prescribe the right exercises for you so that you can maintain a regular exercise routine after this 8-week training program.

Please enjoy the program, and do not hesitate at any time to ask questions. ☺

| ASSESSMENT | PRESCRIPTION OUTCOME |
|---|---|
| Hip assessment incl hip scouring (glut med, anterior hip capsule) + SLR | Glut med/piriformis tightness = stretching prescription |
| | SLR ROM<80° = hamstring stretching prescription |
| Anterior hip capsule pain on shortening – assess strength/endurance vs connective tissue irritation (hip flexor straight leg raise endurance, 45° hip abduction and flexion) | SLR with pain provocation = cat/camel exercise prescription, 6-10 rep range Tissue only – passive stretching intervention |
| | Strength/endurance – repetitions with progression of load over time |
| Quadriceps flexibility | Prone knee flexion, asymmetry and/or inability for feet to touch gluteals = quad specific stretching |
| Review of posture and pain reporting during postural tasks | Postural correction training (neutral spine in standing) |
| | -teach and utilize Split Squat exercise for normal bending |
| | Directional preference training based on centralization assessment |
| | Pain during prolonged standing = localized glut med contractions in excess of 20 reps for an initial set (local muscle endurance), ensure prescription of other trunk focussed exercises have endurance focussed prescription (single set prescription minimum repetition level 20 RM) |
| Squat movement (calisthenic, shoulders flexed to 90°) | Address hinging patterns with application of abdominal bracing in combination with 'big 3'. Individuals progressions based on outline in 2009 paper. Teach hip hinge, teach controlled use of breathing during squat type movement |
| -observation of movement pattern and/or pain provocation | High lumbar/low thoracic hinge = addition of latissimus focussed exercise in addition to big 3 (standing stiff arm pull downs = abdominal/lumbar/latissimus recruitment) and overhead squat technique for prescription |
| -aberrant motion in lumbar spine and or pelvis movement | |
| -valgus knee angle – knee tracking | Rigid postural pattern (i.e. movement is controlled via a knee hinge, upright posture maintained) = teach hip hinge, teach controlled use of breathing during squat type movement, if no lumbar hinge patterns observed mobility work recommended (cat-camel exercise) |
| -trunk angle during movement | |
| -upper thoracic postures during movement | No loss of neutral spine but excessively flexed trunk posture = application of overhead squat technique (broomstick over head) – (probably already has hip flexor issues identified) |
| | Loss of thigh control, excessive valgus knee angle (probably already have glut med issue identified) |
| | Upper thoracic movement patterns; scapula setting techniques during all exercises in addition to basic press up prescription addition and overhead squat. |

| HIP RANGE OF MOTION ASSESSMENT | NOTES |
|---|---|
| Flex hip to chest | |
| Rotate hip around capsule | |
| Take hip (with knee flexed) across body (internal rotation) | |
| **STRAIGHT LEG RAISE** | |
| Right leg range of motion (any pain provoked? – if pain, lower leg slightly, dorsiflex foot, is pain reproduced?) | |
| Left leg range of motion (any pain provoked? – if pain, lower leg slightly, dorsiflex foot, is pain reproduced?) | |
| **QUADRICEPS FLEXIBILITY**<br>(prone knee flexion, single leg testing) | |
| Can they touch heel to gluteals? | |
| Is there an asymmetry? | |
| **DO THEY REPORT PAIN DURING PROLONGED STANDING OR SITTING?** | |
| **IS PAIN PROVOKED WHEN YOU ASK THEM TO....** | |
| Bend forward | |
| Extend | |
| Laterally flex to the left | |
| Laterally flex to the right | |
| Rotate right | |
| Rotate left | |
| **ASK PARTICIPANT TO SQUAT WITH ARMS OUT IN FRONT. DO THEY.....** | |
| Have a high or low lumbar hinge? | |
| Have a very erect trunk posture? | |
| Have a very flexed trunk posture? | |
| Have a thoracic spine that flexes alot? | |
| Show a collapsing knee on one side? | |
| Rotate at the hips while they squat? | |

## APPENDIX 2

Individualized exercise program progression templates.

| Primary Core Stability Exercises and Progressions | |
|---|---|
| Bird-dog | 1. Startup position (neutral spine, set lat contraction)<br>2. Single limb movements to ensure maintenance of neutral spine, appropriate limb contractions<br>3. Progression to contralateral arm/leg and hold for 10 s<br>4. Increase to maximum volume 3 sets × minimum 4 reps each side, 10 s holds<br>5. Progress to arm and leg squares during hold<br>6. Progress to brace and pop<br>7. Progress to full body push-up position for arm/leg raising |
| Partial curl-up | 1. Initial position and basic curl-up movement<br>2. Allow some supports (i.e. elbow on ground)<br>3. Reduce supports<br>4. Progress to brace prior to movement to increase intensity<br>5. Progress to forced breathing during hold<br>6. Progress to hold plus leg repositioning during curl-up |
| Side bridge | 1. Onto wall only<br>2. Partial-side bridge on knees<br>3. Progress to full-body side bridge<br>4. Progress to full-body side bridge with rotation into front plank<br>5. Progress to full-body side bridge plus leg abduction pulse<br>6. Combine 4 and 5 |
| **Prescription Volume Individualized per Participant and Exercise Difficulty: Hip Focused Exercise Progressions** | |
| Hip flexor exercise | 1. Lying hip flexion exercise, bent leg<br>2. Lying hip flexion exercise, full leg extension<br>3. 10 s circles, clockwise, anticlockwise<br>4. Brace then pop |
| Hip abduction exercises | 1. Side lying hip abduction—ensure correct technique (partial extension)<br>2. Reps with full extension |
| Standing hip protocol | 1. 3 direction movements<br>2. 3 direction movements plus pulse at top |
| **Prescription Volume Individualized per Participant and Exercise Difficulty: Squat Progression Options** | |
| **Choice of Exercise as per Individual Requirements. Progressions of Technique, Intensity, Volume Individualized to Each Person.** | 1. Kneeling squat technique<br>2. Split squats<br>3. Bulgarian split squats<br>4. Lunges<br>5. Sumo squats<br>6. Overhead squats<br>7. Calisthenic squats |
| **Stretching Techniques (30 s Holds, 3 Repeats, up to 5× per Week if Prescribed)** | 1. Lying hamstring straight leg stretch<br>2. Seated cross-legged gluteal stretch<br>3. Lying gluteal stretch<br>4. Standing good morning stretch<br>5. Prone quadriceps stretch |
| **Other Low Back Techniques (Prescribed as per Trainer Recommendations)** | 1. McKenzie techniques<br>2. Cat-camel |

## APPENDIX 3

Exercises prescribed in the 0–4 week and 5–8 week phases of the general exercise program. Exercises denoted with an asterisk were prescribed using a 10-s isometric hold during each repetition, for a maximum of 6 repetitions per set for up to 3 sets. For all other exercises, participants were required to move using a consistent cadence and perform up to a maximum of 20 repetitions per set for 3 sets.

| 0–4 Week Exercises | 5–8 Week Exercises |
|---|---|
| *Quadruped (contralateral arm/leg movement) | *Full-body quadruped (from push-up position) |
| *Partial curl-ups | *Full-body side bridge |
| Split squats (aka static lunges) | Walking lunges |
| Push-ups | Alternate hand position push-ups |
| *Supine bridge | *Supine bridge with single leg lifts |
| Overhead squats (hands raised above head) | Standing hip flexion/extension |
| Side-lying leg raises | Sumo squats |