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ORIGINAL ARTICLE

From protection to non-protection: A mixed methods study investigating movement, posture and recovery from disabling low back pain

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Abstract

Background: Movement and posture are commonly believed to relate to low back pain (LBP). Yet, we know little about how people make sense of the relationship between their LBP, movement and posture, particularly after recovery. We aimed to qualitatively explore this understanding, how it changes and how it relates to quantitative changes.

Methods: A mixed method study in the context of an existing single-case design involving 12 people with disabling non-specific LBP. Interviews were conducted before and after a 12-week physiotherapy-led Cognitive Functional Therapy intervention, and qualitative findings from these were integrated with individualized, quantitative measures of movement, posture, psychological factors, pain and activity limitation.

Results: Strong beliefs about movement and posture were identified during the baseline interviews. Lived experiences of tension and stiffness characterized the embodiment of 'nonconscious protection', while healthcare and societal messages prompted pain-related fear and 'conscious protection'. Through varied journeys, most participants reported improvements over time with less protective movement and postural strategies. For some, being less protective required focused attention ('conscious non-protection'), but most returned to automatic, normal and fearless patterns ('nonconscious non-protection'), forgetting about their LBP. One participant reported no meaningful shift, remaining protective. Greater spinal range, faster movement, more relaxed postures and less back muscle EMG accompanied positive changes in self-report factors.

Conclusion: The findings offer a framework for understanding how people make sense of movement and posture during the process of recovery from persistent, disabling non-specific LBP. This involved a re-conceptualisation of movement and posture, from threatening, to therapeutic.

Significance: Findings from qualitative interviews before and after a Cognitive Functional Therapy intervention in 12 people with disabling low back pain highlighted an individualized recovery journey from conscious and nonconscious

protection to conscious non-protection for some, and nonconscious non-protection for many. Pre and post-quantitative measures of movement, posture, psychological factors, pain and activity limitation integrated well with the qualitative findings. The findings suggest movement and posture may form part of a multidimensional pain schema.

1 | INTRODUCTION

Low back pain (LBP) is the most disabling health condition globally (Buchbinder et al., 2020). It's costly (Dagenais et al., 2008; Deloitte, 2019; Ma et al., 2014), and disability levels continue to escalate (Dieleman et al., 2020; Hartvigsen et al., 2018). Numerous biopsychosocial factors are known to contribute to persistent LBP, with psychosocial factors consistently shown to be important (Chen et al., 2018; Maher et al., 2017; O'Sullivan et al., 2016, 2018; Pincus et al., 2002). 'Correct' movement and 'good' posture are often considered important physical factors for LBP, by society (Caneiro et al., 2018; Darlow, Perry, Stanley, et al., 2014), people experiencing LBP (Darlow et al., 2013, 2015; Hush et al., 2009; Lin et al., 2013), and many clinical disciplines (Karayannis et al., 2016; Sahrmann, 2021; Spoto & Collins, 2008; Widerström et al., 2021). But the relevance of movement and posture as LBP improves from individuals' perspectives remains unclear.

Descriptions of restricted, limited, stiff, tense or feared movements and postures are common among qualitative studies of LBP (Bunzli, Smith, et al., 2016; Oosterhof et al., 2014; Pugh & Williams, 2014; Snelgrove et al., 2013) and supported by quantitative findings of more rigid and protective movement patterns in people with LBP compared to those without (Geisser et al., 2005; Laird et al., 2014; Laird et al., 2019). These patterns appear to be underpinned by beliefs of damaged or broken spinal structures and fear of further damage or functional loss during painful activities (Bunzli et al., 2017; Bunzli, Smith, et al., 2016; Bunzli, Smith, Schütze, & Sullivan, 2015; Bunzli, Smith, Watkins, et al., 2015; Oosterhof et al., 2014; Setchell et al., 2017; Snelgrove et al., 2013). However, changes in rigid and protective movement patterns appear unrelated to improved LBP unless individual heterogeneity is accommodated (Laird et al., 2012; Steiger et al., 2012; Wernli et al., 2021; Wernli, O'Sullivan, et al., 2020; Wernli, Tan, et al., 2020). When related to LBP improvement, it seems that movement and posture consistently become less protective (increased spinal range, speed, relaxation and slumping) (Wernli et al., 2021; Wernli, O'Sullivan, et al., 2020; Wernli, Tan, et al., 2020), but how people *conceptualize* this link remains largely unknown.

People with LBP conceptualize recovery as a complex and highly individualized process (Hush et al., 2009). A meta-ethnographic study of 195 qualitative studies exploring recovery from persistent pain highlighted the empowering influence of validation (of pain and as a person) and reconnection (with themselves and the world) that helped people envisage a future but did not specifically identify perceptions about movement or posture (Toye et al., 2021). There is some indication that changes in movement and posture may be relevant in the recovery from LBP. Qualitative quotes indirectly identify the importance of 'moving freely', 'feeling supple' and producing more 'efficient, effective, relaxed and comfortable' movements and postures during recovery (Hush et al., 2009; Pugh & Williams, 2014), but this is under-researched.

Psychological factors, in addition to influencing LBP outcomes (Pincus et al., 2002), also influence movement and posture. More negative factors (for example, increased fear of movement or pain catastrophising) showed consistent, albeit weak, associations with more rigid and protective spinal movement in a recent meta-analysis (Christe, Crombez, et al., 2021). However, more research using "specific and individualised measures of psychological factors, pain intensity, and spinal motor behaviour" was recommended (Christe, Crombez, et al., 2021) (p.683).

The call for individualized assessment aligns with recent calls for person-centred care (Borsook & Kalso, 2013; Kerry et al., 2012; Lillie et al., 2011; Lin et al., 2020). The investigation of change during individualized interventions that target multidimensional factors including movement, posture and psychological factors, provides an opportunity to investigate conceptualisations about movement and posture, and how these change over time. Rigorous replicated single-case, mixed method designs that can readily accommodate heterogeneity provide viable options for research from a person-specific, individualized perspective (Kerry et al., 2012; Kratochwill et al., 2012; Lillie et al., 2011; Toye et al., 2013). They can yield rich, comprehensive and valid clinical findings (Borsook & Kalso, 2013; Fetters & Freshwater, 2015; Lillie et al., 2011; Queirós et al., 2017). Using this methodology, we aimed to:

(i) Understand how people with persistent, disabling LBP conceptualize relationships between movement, posture, psychological factors (pain-related cognitions and emotions), pain or activity limitation and how this conceptualisation changes following an individualized, multi-dimensional intervention.

(ii) Explore how quantitative changes in movement, posture, psychosocial factors, pain and activity limitation integrate with this conceptualisation.

2 | METHODS

2.1 | Design

We used a pre–post triangulation convergent mixed methods design incorporating both qualitative and quantitative approaches in the context of an existing replicated single-case design study. The existing study comprised of a five-week baseline phase, a 12-week Cognitive Functional Therapy (CFT) intervention phase, and a five-week follow-up phase (Wernli, O'Sullivan, et al., 2020). Qualitative data were collected through semi-structured, in-depth interviews before (baseline) and after (follow-up) the 12-week intervention, allowing the participants' perspectives, voices and stories to be heard. We reported qualitative methods and findings in accordance with the COREQ-32 checklist (Tong et al., 2007). Online surveys collected quantitative questionnaire data at baseline and follow-up time points, while wireless, wearable sensors collected movement and postural data weekly for 5 weeks before and after the intervention (Wernli, O'Sullivan, et al., 2020). We were interested in how conceptualisations about movement and posture integrate with quantitative changes in clinical outcome. As we were not interested in treatment efficacy, it is not pertinent to randomize the baseline (such as in a single-case experimental design—SCED) (Kratochwill et al., 2012; Lobo et al., 2017; Tate et al., 2016). This study, therefore, represents a pre–post single-case study design replicated in 12 people.

We registered the study with the Australian and New Zealand Clinical Trials Registry (ACTRN12619001133123). This paper presents the qualitative component of the broader project described in the trial registration as a mixed methods study to provide a richer understanding of the findings (Fetters & Freshwater, 2015). Correlations between patterns of change in quantitative data collected weekly have been reported in a separate publication (Wernli, O'Sullivan, et al., 2020). We used the Checklist of Mixed Methods Elements, Mixed Methods Structure Guide and the Mixed Methods Appraisal Tool to prepare this paper (Fetters & Freshwater, 2015; Fetters & Molina-Azorin, 2019; Hong et al., 2018).

2.2 | Participants

We recruited 12 people with persisting (>3 months), disabling (≥5 on the 23-item Roland Morris Disability Questionnaire [RMDQ]), non-specific LBP who met the eligibility criteria (Box 1). Participants were recruited through social media, referrals from primary care practitioners, and word of mouth. Thirty-one people expressed interest with 19 people excluded because they did not meet the eligibility criteria. Reasons for exclusion included: planned leave of absence greater than two consecutive weeks ($n = 5$), body mass index (BMI) >30 kg/m^2 ($n = 5$) due to the increased likelihood of soft tissue artefacts in the movement sensor data in people with a higher BMI (Laird et al., 2019), RMDQ not ≥5 ($n = 4$), trying to get pregnant ($n = 1$), no reason given ($n = 4$).

2.3 | Setting

The study occurred in metropolitan Perth, Western Australia, in two waves (each 22 weeks) of six people

BOX 1 Selection criteria

Inclusion criteria	Exclusion criteria
Adults aged 18 years or older	Dominant leg pain
Primary complaint of LBP (between T12 and gluteal folds)	Diagnosis of LBP related to specific pathologies (infection, cancer, inflammatory disorders, fracture, radicular pain with neurological deficit)
Persistent (≥3 months duration)	Pregnancy
Disabling (≥5 on RMDQ)(Patrick et al., 1995)	Inability to adequately speak or understand English
Non-trivial (≥3/10 across three 11-point Numerical Rating Scales identifying current, average and worst pain over the last week) (Manniche et al., 1994)	Body Mass Index >30 kg/m^2 (due to the increased likelihood of soft tissue artefacts in the movement sensor data in people with higher BMI) (Laird et al., 2019)
Pain provoked by movements or postures	Nondisabling LBP (mean baseline Patient-Specific Functional Scale [PSFS] score <3/10 for 2 consecutive weeks)
	Planned leave of absence greater than 2 consecutive weeks throughout the 22-week study period (due to the frequent and intensive measures)

between January and December 2018. We collected qualitative and quantitative data at a primary care musculoskeletal physiotherapy practice (also the location of the intervention) or the participant's home. The Curtin University Human Research Ethics Committee approved the study (approval number HRE2017-0706), and each participant provided written informed consent.

2.4 | Intervention

All patients underwent a 12-week, individualized, physiotherapy-led CFT intervention. Following the exclusion of specific causes of LBP, CFT targets modifiable cognitions, emotions, movements, postures and lifestyle factors identified to contribute to an individual's ongoing pain and activity limitation (O'Sullivan et al., 2018). CFT has shown clinically significant and sustained improvements in pain and function (O'Sullivan et al., 2015; Ussing et al., 2020; Vibe Fersum et al., 2013; Vibe Fersum et al., 2019) and is often accompanied by changes in the way people conceptualize their pain (Bunzli, McEvoy, et al., 2016).

Four specially trained physiotherapists provided up to 10 sessions of funded CFT depending on the participants' clinical course. The physiotherapists had undergone competency assessment by the developer of CFT (POS). To ensure treatment fidelity, POS observed the initial session and maintained regular contact with the treating physiotherapists during the intervention. The initial intervention session was 60 min, while subsequent sessions were 30–45 min.

2.5 | Procedures

The data collection and analysis procedures for the triangulation convergent mixed methods design are presented in Figure 1.

2.5.1 | Qualitative component procedures

The theoretical framework adopted for this study was the Common-Sense Model (Leventhal et al., 2016), while our methodological approach was interpretive description (Thorne et al., 1997). This approach integrates the individual experiences of the person experiencing LBP with the research teams' expertise in the condition to form credible, rigorous and valid knowledge (Thorne et al., 1997; Thorne et al., 2004).

2.5.2 | Researchers

The researchers comprised musculoskeletal and cardiopulmonary physiotherapists and a biomechanist, all with experience in qualitative and quantitative methods. All authors have clinical and research interests in the biopsychosocial understanding of health conditions.

2.5.3 | Data collection

One author (KW, BSc, male) conducted one-on-one, face-to-face, semi-structured, in-depth interviews. They occurred primarily at the participant's homes or on occasion

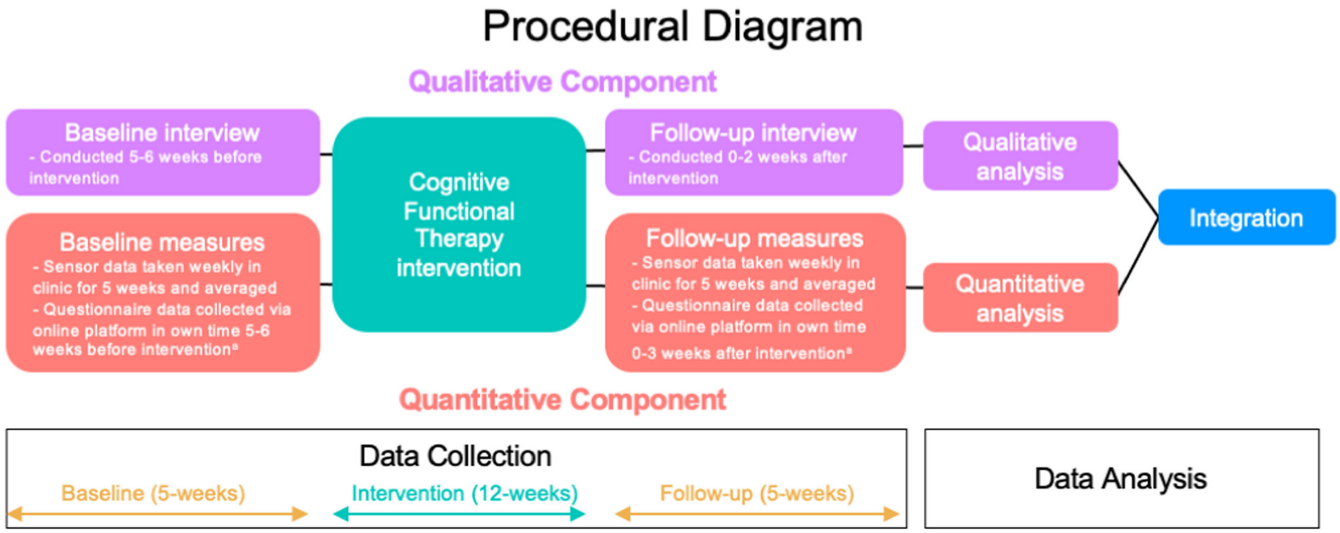

FIGURE 1 The data collection and analysis procedures of the triangulation convergent mixed methods design are presented graphically. [a]Pain intensity, bothersomeness, interference, pain control and trust in the back were captured weekly during the baseline and follow-up phases and averaged.

at the physiotherapy practice or the participants' workplace. Aside from P3, the interviewer was not previously known to the participants. The participants were aware the researcher was a practicing physiotherapist completing a PhD. The interviewer did not provide the intervention. All interviews were recorded on a digital voice recorder with the participants' permission. Questions were open-ended and centred around exploring the participants' experiences, beliefs and emotions relating to movement and posture, particularly how movement and posture related to their LBP experience. Specific movements and postures that participants reported as problematic were explored under the common-sense model of illness (cognitions, emotions, actions and appraisals related to problematic movements and postures, and their LBP) (Leventhal et al., 2016). The interviewer gave prompts and space to explore meaning and allow divergence into relevant topics. Pertinent quotes from each participants' baseline interview were repeated at their follow-up interview to stimulate reflective discussion and explore meaning (data-prompted questions) (Kwasnicka et al., 2015). Example interview questions can be found in Appendix S1.

In addition to experiencing and observing several clinical encounters with the target population, the interviewer had conducted multiple pilot interviews, which were reviewed by senior members of the research team, including those with expertise in qualitative methodology. Further, the pre-interview conversation included verbally revisiting the consent for the interview to occur and be recorded. Additionally, the interviewer clarified that his role was as an interviewer aiming to hear the participants' voices without prejudice, not as a physiotherapist. That conversation also included prompts for the participants to speak honestly and not try to say what they thought the interviewer wanted to hear. This reflexivity practice also helped the researcher ensure his lens remained as an investigative interviewer rather than a physiotherapist.

2.5.4 | Data analysis

We used reflexive thematic analysis as the analytical method in keeping with our interpretive description methodological approach. Recorded interviews were transcribed verbatim and uploaded to MAXQDA (VERBI Software, 2019) to facilitate analysis. As interpretive description uses clinical knowledge to build on findings, we did not deem it important to return transcripts to participants (Klem et al., 2022). Participants did not provide feedback on the findings. For each interview, one author (KW) listened to the interview in its entirety while making memos throughout the transcript. Then, as per the interpretive description methodological approach (Thorne et al., 1997), data that related to the question of: "how does this person conceptualise the relationship between movement, posture, and their LBP?" were classified into the categories reflecting an adapted common-sense model (see 'Category' column in Appendix S2). Inductive, open coding methods were then used to analyse raw data from each category (Thorne et al., 1997). For example, under the 'Lived experience' category, codes such as: "feeling stiff/restricted/seized up" and "moving freely/with flexibility" were identified. Frequent meetings (approximately three per month) among the research group, discussions among peers, as well as reflective memos kept by the lead author enhanced reflexivity throughout the data analysis process.

Three authors (KW, AS, POS) then independently performed inductive open coding on three participants' pre- and post-transcripts (six transcripts in total) to form a codebook. Coded transcripts were compared among these three authors over several meetings to reflect on how each researcher coded the data, made assumptions or may have overlooked aspects of the data (Braun & Clarke, 2020). Additionally, a fourth researcher (FC) outside of the research group and with limited exposure to CFT or the common-sense model coded the transcripts of three participants as a method of peer review and to provide additional perspectives.

The codebook was refined during the process of coding the subsequent four participants, after which no new codes or themes were identified (i.e., saturation occurred after seven participants, with the remaining five participants validating the codebook).

Following open coding, five researchers (KW, POS, AS, AC and PK) then compiled the data under each category for the three participants that were cross-coded and identified salient intra-person themes for these participants. One researcher (KW) then completed intra-person analysis for the remaining nine participants. Two authors (KW and AS) then discussed any patterns between participants (inter-subject analysis) and identified themes, which were then discussed among the research group. We explored negative or divergent cases and codes to establish further understanding.

2.5.5 | Quantitative component procedures

Data collection

Self-report questionnaires. We used the Qualtrics platform for the online questionnaire. The participants completed the questionnaire in their own time using a mobile device or computer. The following outcome measures were collected on all participants before and after the 12-week CFT intervention:

- Pain (collected weekly during baseline and follow-up period then averaged to identify a single pre- and post-measure):

  - Intensity—Tri-Numerical Rating Scale (NRS) (mean of current, average over last week, worst over last week on 0–10 NRS) (Manniche et al., 1994)
  - Pain interference (0–10 NRS) (Dionne et al., 2008)
  - Pain bothersomeness (0–10 NRS) (Dunn & Croft, 2005)

- Pain-related activity limitation:

  - Roland Morris Disability Questionnaire (RMDQ) (23 item) (Patrick et al., 1995)—measured at the start and end of 5-week baseline and then averaged for baseline value, measured once at the beginning of follow-up
  - Patient-Specific Functional Scale (PSFS) (Westaway et al., 1998) (collected weekly during baseline and follow-up period then averaged to identify a single pre- and post-measure)

- Pain-related cognitions (measured at the start and end of 5-week baseline and then averaged for baseline value, measured once at the beginning of follow-up unless otherwise indicated):

  - Pain self-efficacy—Pain Self Efficacy Questionnaire (PSEQ) (Nicholas, 2007)
  - Pain catastrophising—The Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995)
  - Body perception—Fremantle Back Awareness Questionnaire (Fre-BAQ) (Wand et al., 2014)
  - Pain controllability—3 item questionnaire adapted from Jensen and Karoly (1991) (collected weekly during baseline and follow-up period then averaged to identify a single pre- and post-measure)
  - Back pain beliefs—Back Pain Attitudes Questionnaire (Back-PAQ) (Darlow, Perry, Mathieson, et al., 2014)
  - Trust in back—Single item answering, 'I trust my back' (0 = no trust, 10 = complete trust) (collected weekly during baseline and follow-up period then averaged to identify a single pre- and post-measure)

- Pain-related emotion (measured at the start and end of 5-week baseline and then averaged for baseline value, measured once at the beginning of follow-up):

  - Fear of Movement—Tampa Scale of Kinesiophobia (TSK) (Swinkels-Meewisse et al., 2003).

The short form Örebro Musculoskeletal Pain Screening Questionnaire was also collected at the end of the baseline phase (Linton et al., 2011). While self-report questionnaires were administered during the intervention period, these were not included in the current analysis in order for the collection periods to align with the qualitative interviews. This allowed better integration between the qualitative and quantitative findings. Further, we chose to collect the self-report questionnaires and the movement assessment sessions at weekly intervals (as opposed to daily) for a number of reasons. Firstly, the completion of the self-report questionnaires took approximately 5–10 min, and the movement assessment sessions took approximately 30 min to complete, so it would have been impractical and burdensome for participants to complete the questionnaires and have to attend the clinic daily for the movement assessment. As we were interested in relationships between conceptualisations, movement, posture, pain, activity limitation and psychological factors, having alignment between the frequency of data collection was deemed important. Secondly, asking daily questions about pain, activity limitation and other pain-related variables may inadvertently increase pain vigilance or a focus on the impact of pain. So, weekly measures were chosen to find a balance between participant burden, capture relevant measures at similar timepoints, and minimize focus on pain.

2.5.6 | Measurement of movement and posture

The participants each nominated three movements or postures that they found most problematic on the PSFS. These were measured by wearable sensors (V5 ViMove hardware and software, DorsaVi, Melbourne, Australia) on a weekly basis at the physiotherapy clinic during the 5-week baseline and 5-week follow-up period. A researcher (KW) blind to clinical outcome (questionnaire) data and not involved with the intervention collected the movement and posture data. Sagittal plane kinematics were collected by two wireless inertial measurement units (placed over the spinous process of T12 and S2) sampling at 20 Hz. Lumbar muscle activity was collected by two wireless surface electromyographic (EMG) sensors (placed two centimetres on either side of the L3 spinous process following light abrasion and cleaning of the skin) sampling at 300 Hz. We collected three repetitions of each nominated movement and 15 s of unsupported, self-selected postures. This ecologically valid clinical sensor system facilitated the frequent measures and has demonstrated clinically acceptable agreement compared to the Vicon motion capture system, the industry-standard (Mjosund et al., 2017). Further information about the sensor specifications, normalization, calibration and processing procedures are detailed in Wernli, Tan, et al. (2020) (Wernli, O'Sullivan, et al., 2020).

2.5.7 | Data analysis

Questionnaire data were collated for each participant. As we had a variable number of baseline self-report outcome measures (for example two RMDQ and TSK, but five pain intensity, pain control and trust), we chose to average within construct these data to form a singular 'pre' value. Because our research questions were about understanding how conceptualisations about movement or posture change and how these integrate with quantitative changes (we were not interested in treatment efficacy), whether self-report outcomes were already improving during the baseline period was not pertinent in this context. Similarly, where we had multiple measures of the same construct during the follow-up period, these were averaged to form a single 'post' value. We analysed movement and postural data as per the previously published replicated single-case design (Wernli, O'Sullivan, et al., 2020) and calculated a mean value of relevant movement and postural data for the 5-week baseline and 5-week follow-up period, forming a single pre- and post-value.

2.5.8 | Integration

We integrated qualitative and quantitative findings using a joint display to draw meta-inferences across the two types of data. This integration method is in line with the premise that the strength of a mixed-methods study lies in the integration of the two data types, garnering a richer understanding than the data types in isolation (Fetters & Freshwater, 2015).

2.6 | Data transparency

For qualitative data, deidentified direct quotes are embedded in the results of this paper with additional supporting quotes presented in Appendix S3. Full transcripts are not presented to protect the privacy of the individuals as they contain potentially identifiable information. De-identified full transcripts are available from the lead author at reasonable request. For quantitative data, all baseline and follow-up measures are reported for each participant in the results section or Table S2. Raw data used to calculate the mean of each participants' baseline and follow-up phase are available from the lead author at reasonable request.

3 | RESULTS

All 12 participants completed the study, and their de-identified demographic and clinical characteristics are presented in Table 1 (with detailed descriptions provided in Table S1). Their median (range) baseline demographics were; age: 39 years (22–76), duration of LBP: just over 4 years (11 months–17 years), RMDQ score: 17.5/23 (12–22) and Örebro Musculoskeletal Pain Questionnaire short form: 56.5/100 (41–79), with 10/12 participants scoring

TABLE 1 Participant demographics. Additional demographic and clinical details are presented in Table S1

	Key baseline demographics				
Participant	Age (years)	Gender	Duration of LBP	RMDQ (0–23)	Örebro (10-item) (0–100)
P1	76	Female	1 year (episodic 15 years)	15	58
P2	38	Male	5 years and 3 months	17	54
P3	40	Female	1 year 8 months	18	57
P4	33	Male	9 years	16	56
P5	68	Male	5–6 years	12	45
P6	28	Female	11 months	19	79
P7	26	Female	7 years	22	49
P8	50	Female	5 years	18	54
P9	43	Male	17 years	10	60
P10	22	Female	6 years	12	67
P11	26	Male	6 years	19	68
P12	56	Male	3 years	18	41

Abbreviations: LBP, low back pain; RMDQ, 23-item roland morris disability questionnaire.

above the cut-off (>50) for high risk of future disability (Linton et al., 2011). The participants reported significant previous engagement with the healthcare system, consulting with multiple healthcare professionals, including physiotherapists, chiropractors, naturopaths, osteopaths, general practitioners, radiologists or orthopaedic surgeons (participant 12 had a spinal fusion as part of a workers compensation claim). Many participants reported taking significant time (up to 4 years) off work due to their LBP and frequent medication use (including 4/12 reportedly using opioids). Most participants (7/12) reported other medical co-morbidities (such as atherosclerosis, reflux, bronchiectasis, anxiety, depression, post-traumatic stress disorder, migraines, elevated cholesterol, tinnitus, lupus, hyperthyroidism) and family histories of LBP (7/12). Qualitative interviews lasted approximately 60 min (30–100 min), and all participants completed all qualitative interviews. All data required for the quantitative analysis were available. No participant dropped out of the study or chose to terminate an interview. Themes and supporting quotes are presented in text (with additional supporting quotes presented in Appendix S3), while quantitative and integrated findings are presented in Table 2.

3.1 | Qualitative findings

Findings from the qualitative analysis revealed distinct themes of protection during the baseline interviews and non-protection, or less protection, during the follow-up interviews. This journey from protection to non-protection is presented in Figure 2.

3.1.1 | Baseline interviews

Inductive coding under the theoretical framework of the common-sense model categories (lived experience, cognitions, emotions, actions and appraisals) led to the generation of many sub-categories (detailed in Appendix S2) relevant to our key aim of understanding how people with LBP *conceptualize* the link between their movement or posture and their condition. The overarching theme identified during the baseline interviews was one of protection. A 'conscious to nonconscious pathway of recovery' strongly identified in the follow-up interviews prompted the reflection of whether there were conscious and nonconscious distinctions in the baseline interviews. In the baseline data, codes under the 'lived experience' suggested an automatic, habitual protective pattern learned by the body (a nonconscious response), while codes under the 'cognitions' category suggested clear reasons for conscious protective and avoidance patterns clearly identified from the baseline interviews. These findings led to the key themes of 'nonconscious protection' and 'conscious protection' during the baseline period—both accompanied by overlapping cognitions, emotions, actions and appraisals.

3.1.2 | Nonconscious protection

During the baseline interviews, all participants conveyed varying lived experiences of their back feeling 'stiff, tight, tense, spasming, rigid and locked or seized up' during painful movements and postures. Commonly, they believed this was because of something being wrong, injured or damaged in their back. We viewed these experiences as an automatic, nonconscious bodily response to try to protect the back:

> "(My movement) gets more rigid. It slows down, and it just seizes up really... I feel tightness. For sure. Pretty much all the time... it's kind of like, just like a pulling to the centre of where the injury is" – P2 baseline

> "No. No (I don't feel relaxed in my back). It's always in protection mode... protecting whatever is wrong" – P8 baseline

> "(It's stiff because) I mean I'm no doctor, but looking at the x-rays of my back, you can see the vertebrates quite close together... it has too much damage, all the tissue is sort of worn out" – P9 baseline

3.1.3 | Conscious protection

While participants detailed lived *experiences* of feeling 'stiff, tight and restricted' during the baseline interviews (nonconscious protection), they also described *consciously* doing things to protect their back. For example, all participants reported that since the onset of their back pain, they were careful and cautious with their movements and postures:

> "I have to be careful about everything I do and how I do everything" – P7 baseline

> "I'm just always conscious of everything I do... At work, I'm having to think about everything I do all day long" – P9 baseline

TABLE 2 Integrating the qualitative and quantitative findings for three exemplar cases from each qualitative group based on the follow-up interviews. P1-conscious protection, P5-conscious non-protection, and P8-nonconscious non-protection

Participant. Group membership at follow-up	Qualitative		Quantitative		
	Baseline (B)	Follow-up (FU)	Measure	B	FU
Participant 1. Remained in the protection group. "I'm probably careful not to go sideways or off the centre too much... By coming up straight. Not sideways or twitching left or right, coming up straight... because I'm scared of what might happen if I don't." - P1, follow-up interview	"Getting more and more stiff. Well, it spasms, isn't it? Would you call it spasms?" "Thinking back, there might have been some damage done there."	"KW: has your stiffness from muscle spasm changed? P1: No, I think it's there constantly. It doesn't really change." "to me it's just that I've got, I've done some damage there.... And to just do the normal things I'm at a disadvantage because my back doesn't like it anymore and until it's repaired, It's not going to give me less pain)"	Bending		
			ROM[a]	110°	115°
			Speed[a]	30°/s	51°/s
			Muscle activity[a]	NA	NA
			Pain[a]		
			Intensity[b]	6.1	5.1
			Interference	5.8	4.6
			Bothersomeness	7.8	4.8
			Activity limitation		
			RMDQ[c]	15	14
			Bending PSFS[a]	6.8	7.2
			Psychological factors		
			TSK[c]	36.5	30
			PSEQ[c]	54.5	51
			PCS[c]	21	17
			FreBAQ[c]	15	11
			BAckPAQ[c]	−1	0
			Pain Control[a]	4	6.3
			Trust in back[a]	2.2	3.2
Participant 5. Progressed to the conscious non-protection group. "I'd like to be able to do it instinctively, but things aren't instinctive yet. I still haven't learnt the new method as an instinct, I've got to break away from the old methods. It takes time." - P5, follow-up interview	"(movement is) probably more rigid than anything else. Because my back seems to get stuck, lacks its fluidity. It's not fluid at all. I don't feel it's a smooth movement in any direction on my back at all. No smoothness."	"(Movement is) fluid and coordinated. You're not taking your next step worrying about the pain coming. Again, you're probably more relaxed... It's far more fluid. It's certainly not spasmodic... there's less tension there than there was before. Some of the tension before I created myself... by bracing, breathing in and tensing the muscles up before I tried anything. I think that made it worse... I'd like to have somebody do a measure of my body tension, because I would think my body tension has gone down by about half, easily."	Bending		
			ROM[a]	70.2°	87°
			Speed[a]	45.6°/s	44.3°/s
			Muscle activity[a]	0.001	0.0006
			Sitting		
			Pelvic angle (positive = APT)[a]	1.3°	1.5°

(Continues)

TABLE 2 (Continued)

Participant. Group membership at follow-up	Qualitative		Quantitative		
	Baseline (B)	Follow-up (FU)	Measure	B	FU
	"KW: In terms of predicting your back pain? P5: No control at all...None. That's the frustration...I just get angry every now and then... particularly when you've gone for a week, no drama at all and all of a sudden, bingo. Where did that come from?"	"KW: How much control do you feel you have over your pain now? P5: A lot. Not a hundred percent, but a lot. KW: How do you control it? P5: By thinking before I leap... KW: When you say you think before you leap, what are you thinking about? P5: Oh, the breathing and relaxing, you know, just not that tension. Try and reduce the tension in your body."	Pain[a]		
			Intensity[b]	5.7	1.7
			Interference	5.8	1
			Bothersomeness	6.2	1
			Activity limitation		
			RMDQ[c]	12	8
			Bending PSFS[a]	5.8	1.6
			Sitting PSFS[a]	4.7	0.4
			Psychological factors		
			TSK[c]	34.5	35
			PSEQ[c]	49.5	40
			PCS[c]	8.5	10
			FreBAQ[c]	11	10
			BAckPAQ[c]	−3	6
			Pain Control[a]	4.9	8.7
			Trust in back[a]	5.2	7.8
Participant 8. Progressed to the nonconscious non-protection group. "Before it was a lot more of, there was lots of thought that went into that bend and it's like: 'can I actually do this?'. 'Is it going to hurt?', 'just be careful'. Whereas now it's just automatic. I bend, I pick up, I come up, and that's good." - P8, follow-up interview	"(stiffness) It's what I feel. I'm putting it down to stiffness; whether it is stiffness or whether it's actually a bit more than that I'm unsure... I'm unsure if there's been more damage, or is it just stiffness, I don't know."	"There is a lot more flexibility in the muscles right now (my movement) feels more free... doesn't feel so restricted." "If I stand how I would normally with my back pretty what I call straight, it just puts tension through the whole back and into the glutes. So, but whereas if I lean forward a tinge... it just takes the pressure off... it releases, it relaxes, there is no tension... there's no pain then."	Standing		
			Pelvic tilt (positive = APT)[a]	26.6°	23.7°
			Bending		
			ROM[a]	74.8°	94.6°
			Speed[a]	29.5°/s	59.7°/s
			Muscle activity[a]	0.0002	<.00001

TABLE 2 (Continued)

Participant. Group membership at follow-up	Qualitative		Quantitative		
	Baseline (B)	Follow-up (FU)	Measure	B	FU
	"I think (the damage is) coming from I would say would be the fall I had (5 years ago), and damage to, I don't know that, I think my guess would be something in the lower back…my thought is something's broken or something's tight. Somethings not working."	"(movement) actually feels really good. So, I'm not afraid to bend. I'm not afraid to pick up things off the floor… What un-packed it for me was moving and realizing that it's not damaging anything. It won't damage anything… to get rid of that damage idea, was a big thing for me."	Pain[a]		
			Intensity[b]	5.8	0
			Interference	3.7	0
			Bothersomeness	5.0	0
			Activity limitation		
			RMDQ[c]	18	0
			Standing PSFS[a]	6.3	0
			Bending PSFS[a]	5.3	0
			Psychological factors		
			TSK[c]	37.5	18
			PSEQ[c]	37.5	60
			PCS[c]	15.5	0
			FreBAQ[c]	18	2
			BAckPAQ[c]	4	50
			Pain Control[a]	4.6	10
			Trust in back[a]	2.8	10

Abbreviations: APT, anterior pelvic tilt; BackPAQ, back pain attitudes questionnaire; FreBAQ, Fremantle back awareness questionnaire; PCS, pain catastrophising scale; PSEQ, pain self-efficacy questionnaire; PSFS, patient-specific functional scale; RMDQ, roland morris disability questionnaire; ROM, range of motion; TSK, Tampa Scale of Kinesiophobia.

[a]Mean of weekly measure during baseline and follow-up period.

[b]Mean of current pain, worst pain over last week, and average pain over last week.

[c]Mean of baseline 1 and baseline 2 long questionnaire.

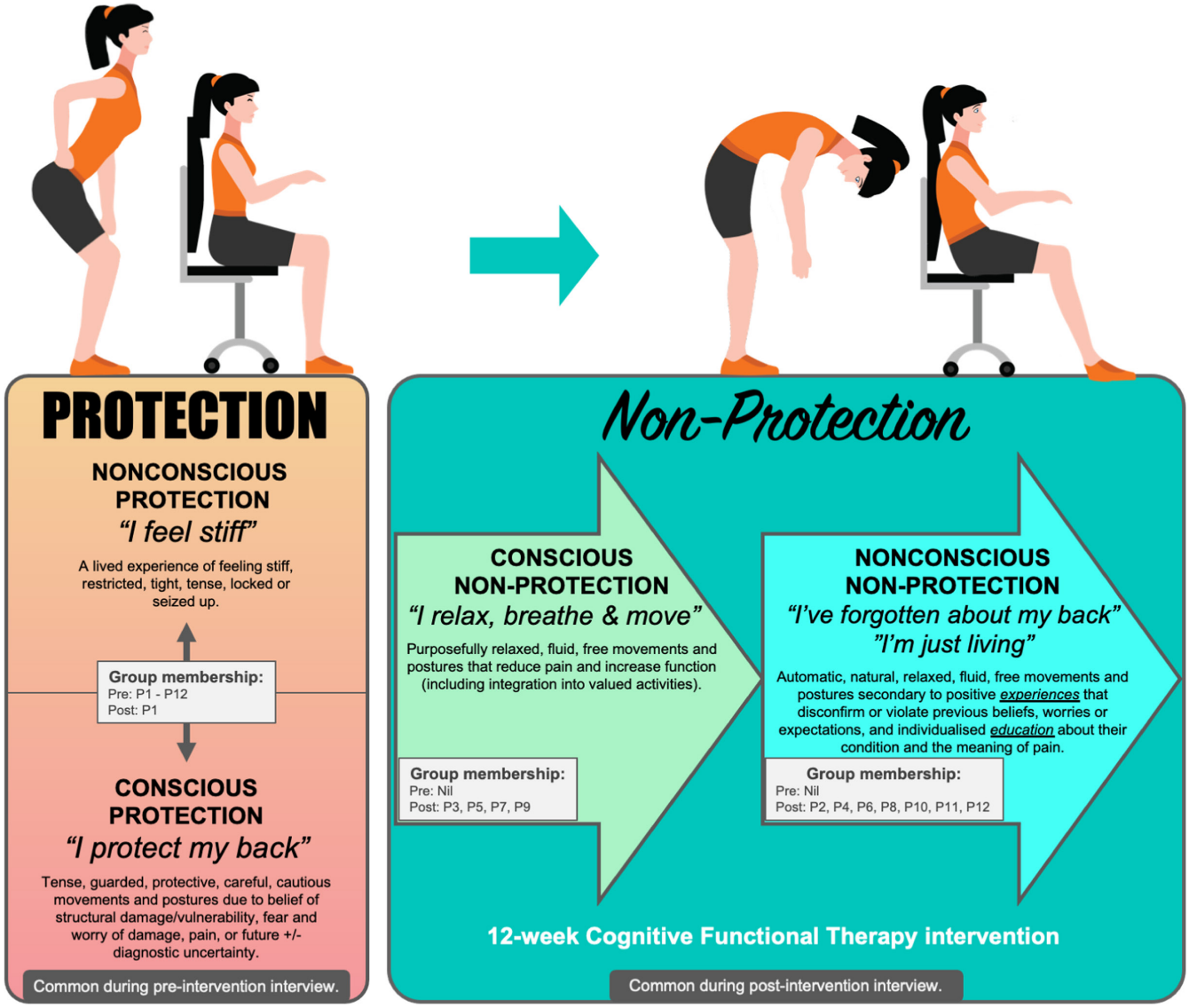

FIGURE 2 The journey from pain and protection to non-protection and just living

Conscious 'protection' involved following rules around posture and movement such as sitting upright, lifting with a straight back and bent knees, or bracing the core. The origin of these 'rules' varied between participants, but common sources were previous encounters with health professionals and historical societal beliefs:

> "They (the previous physiotherapists) said not to slouch... don't sit lounging on a lounge. Don't put your legs up... I think it was laying on your stomach is bad for it... just watch yourself when your lifting... bend your knees... so that you're not arching (bending) your back over." - P2 baseline

While the 'conscious protection' during the baseline interviews manifested in *protective* movement and postural patterns, it was also associated with explicit *avoidance* of perceived threatening tasks:

> "Yeah (I avoid bending altogether), I squat or yeah, use my little grabby thing... I avoid a lot of things because it hurts too much. "– P7 baseline.

While some participants appraised the protective and avoidance patterns as helpful, especially in the short term, and believed that if they could just follow their movement and postural rules more often, they would have control over their pain, most reported a lack of control over their condition:

> "So, it has control, really, because I obey the pain. But therefore, since I have strategies to control the pain (sit up straight, avoid painful

> tasks), I do have some influence over it too. Yeah. So I think it's got a lot of power over me, but I've got a little bit of a way of appeasing it." – P12 baseline

For those who appraised the protective patterns as helpful, further questioning highlighted how the conscious protective behaviours contrasted to a lack of conscious protection or worry about their back before they had LBP. Interestingly, conscious protection was maintained despite some participants reporting experiences where more relaxation was *less* painful, or where muscle tension and following 'postural rules' aggravated their pain:

> "Oh well I didn't worry (about picking the shopping bags up) three years ago. I'd just do it. Now I take caution not to do it. Just because I don't want to end up being on my bed for the rest of the day or the next day" – P3 baseline

> "(Sitting upright) makes it worse, but I just thought I'm meant to keep my posture upright." – P6 baseline

3.1.4 | Cognitions

The dominant cognitions reported by the participants at baseline were that their stiffness and pain experienced during movements and postures meant that something was structurally wrong, damaged, broken or injured. Many participants also reported that they believed their posture was 'bad' or that they must have been historically moving or posturing themselves 'incorrectly'. Together, this led to the participants believing that their back was fragile and vulnerable to further damage or injury.

> "You are so fragile to doing little activities." – P11 baseline

> So, I just think, one little wrong tilt and you're broken... I've been very careful because constant back pain reminds you to be careful, which is good. But even a little, even if I look at my back wrong, it reacts." – P12 baseline

The belief of spinal fragility and vulnerability was, in part, due to strong aversive experiences of pain, but also from encounters within healthcare and society. Similar to the origin of the postural 'rules', specific explanations from healthcare professionals, interpretations of spinal imaging and societal messaging all contributed to the damage and fragility beliefs:

> "I had an MRI and showed the results to the doctor, and the doctor basically said you should stop doing any sort of physical activity, and swimming is all I should do." – P4 baseline

3.1.5 | Emotions

The constant protection (both cognitively and behaviourally) appeared to lead to a heightened state of pain vigilance associated with negative emotions. Emotions such as fear, worry, depression and frustration were related to the impending further damage to their structures, as well as the potential functional consequences, the unpleasantness of pain exacerbations, and the future.

"That's ('slipped disc') pretty much my main fear because that's the, when I talked to other people with back pain, the slip disc disorder is the worst." – P4 baseline

> "If I'm like this at 50, what am I going to be like at 70. To me I worry because it's, yeah, I need to be able to move. If I can't move now, in 10 years' time, you know, what am I going to be in a wheelchair? It freaks me out it honestly does." – P8 baseline

> "I think it annoys me to a point where I get kind of cranky and. Oh, I got to be careful because I am a person that suffers from depression. So that can kick in, and it can just be snowballing to where I don't want it to go; in a space where I just go, I can't do this anymore. I'm not doing it." – P8 baseline

3.1.6 | Follow-up interviews

During the follow-up interviews, most participants (11/12) no longer discussed protecting their back. Rather, they reported that not protecting their back by learning to relax their back muscles and regain normal patterns during threatening movements and postures actually helped them reduce their pain. They reported that this in turn helped reduce their beliefs about damage and worry. This initially led to a strong focus on moving or posturing themselves in 'less-protective' or 'non-protective' ways (conscious non-protection), with some participants

progressing back to automatic, habitual and fearless movements and postures (nonconscious non-protection).

3.1.7 | Conscious non-protection

Consciously 'relaxing' and 'breathing' during pain provoking movements and postures commonly yielded reductions in the participant's pain. For most, these experiences of pain reduction by consciously changing their movement and posture were powerful learnings, and often surprising, both in their simplicity and their contrast from the common societal and healthcare messages. These experiences disconfirmed their previous beliefs of damage or that something was wrong with their spinal structures and meant that previously frightening and threatening painful movements became therapeutic. That process was facilitated by new clinician messages that gave permission to move instead historical messages of 'do not move', 'protect' or 'avoid'.

> "Doing everything opposite to the way that you're told to do it... feels better... way better" – P11 follow-up

> "I thought I was stuck with it for life. So, the fact that it's been as simple as just changing a few of my movements and, you know, looking at my sort of levels of tension... I can't believe that that was all I had to do all along, you know, that it was basically my own kind of, the onset of pain was probably caused by what I was doing, as opposed to something failing in my body." – P9 follow-up

While the power of being able to reduce pain by 'relaxing and breathing' was obvious to most, some participants (P3, P5, P7, P9) reported that this new way of moving and posturing themselves was not automatic yet... non-protection still required conscious attention:

> "I do everything mainly different. I walk different, I sit different. I constantly have to remind myself to do it, and it's not automatic yet. But yeah, I do a lot of things differently." – P7 follow-up

3.1.8 | Nonconscious non-protection

While some participants reported that reducing their pain by consciously modifying their movement and posture gave them a sense of control over their condition, and led to significant improvements in their function, many participants (P2, P4, P6, P8, P10, P11, P12) progressed further, reporting a return to habitual and instinctive movements and postures. By progressing from conscious non-protection through to nonconscious non-protection, these participants had regained automatic, fearless movement and no longer considered themselves to have a back problem:

> "Before, it was a lot more of, there was lots of thought that went into that bend and it's like 'can I actually do this?', 'is it going to hurt?', 'just be careful'. Whereas now it's just automatic. I bend, I pick up, I come up, and that's good... I'm certainly not moving like a grandma anymore. I can move a lot faster, which is nice. It's really, really good to feel like I can move. I don't have to think about it. I don't. In fact, I think I'm at the point where I generally don't give it a lot of thought. I tend to just do." – P8 follow-up

> "(Before, I'd be) bending my knees, keeping my back straight, trying to pick up correctly, now I don't give a f**k... I don't think about it, I just do it." – P11 follow-up

3.1.9 | Cognitions

During the follow-up interviews, most of the participants reported that they no longer believed that their pain was due to damaged structures. Instead, the participants perceived that the protective patterns (such as muscle tension) they had adopted because of these damage beliefs were the dominant contributor to their pain.

> "There was no damage...I think I just filled the 'so called' injury by continuing that protection mode of movement because I thought I was damaged."– P8 follow-up

The reconceptualisation from 'protect my damaged back' to 'it's safe to move' was facilitated by two key factors, experiential learning and personalized evidence-based education. The powerful experiences of less or no pain during threatening tasks made many participants question their previous understanding of what was causing their pain. These experiences often resulted in participants no longer thinking that their body was fragile and vulnerable:

> "But the biggest thing would have been the, the Jefferson curls (round back deadlift

during the second session). Just having my worst-case scenario put in front of me, the scenario where I go, 'if I do this, a hundred percent, my back would break'. And then when you do it and you're fine, then that just, yeah, that flips your world upside down." – P4 follow-up

"What un-packed it for me was moving and realizing that it's not damaging anything. It won't damage anything." - P8 follow-up

Instead of uncertainty, the participants reported how the evidence-based education that supported the experiential learning helped to make sense of their pain. There was also a sense of building self-efficacy and being discharged from care for some participants:

"Because things actually like made sense. It was the most sense anyone had probably said to me. More than instead of just going, 'yeah we're going to give you like pain meds, or we're just going to shove needles in your back' or stuff like that. It's that the physio actually wanted to fix it and then have a long-term goal and not a short-term fix. So then yeah, the physio wants to get rid of me eventually." – P7 follow-up

"I do not find it odd at all anymore (that using the back makes it stronger). I feel that it totally makes sense." – P12 follow-up

3.1.10 | Emotions

These reconceptualizations of the links between movement and pain helped shift emotions of fear, worry, frustration and depression expressed at baseline to happiness, hope, confidence and trust

"Look, I feel pretty positive about it (the future). It's exciting to think that it's given me; it's almost a new lease on life. I can start, I'm starting to look at things that I had pretty much swept under the rug you know, stuff like playing tennis or golf was something, you know I might go and do it occasionally, but it was, I'd pretty much resigned to the fact that I wasn't going to play those sorts of sports anymore." – P9 follow-up

"I feel good. I'm happy I can; I'm not afraid anymore. I can do what I want. I can play more sport; I can lift heavier weights. Um, I don't have that fear of being injured and crippled and old and disabled. So, I've just got free reign to, to live my life how I want... I can trust it to a point where I'm not afraid to, well, yeah, I'm not afraid of my future. I'm not afraid that when I'm older I'm not going to be able to play with my kids or lift my dog or carry my wife, or like... I can do whatever." – P4 follow-up

3.1.11 | Residual protection

While rare, lived experiences of bothersome tension, tightness and stiffness were still occasionally reported during the follow-up interviews. This was particularly true for Participant 1, where a nonconscious tendency to tense up remained. She maintained a protective movement and postural pattern and reported a profound dis-ease with relaxing. Despite relaxing potentially feeling better physically, it felt 'un-natural' and worse psychologically:

"I can't do it all day. As soon as I'm relaxed and find some little bit of relief and then continue what I'm doing, you probably don't continue in the same relaxed mode because you're concentrating on what you're doing, and you might relapse into more tightness of muscle... It's difficult to concentrate on the relaxation, and to me, it doesn't feel natural... Psychologically, no (it doesn't feel better). See, that's the problem. It's so ingrained - psychologically it's not right, maybe physically it's better." – P1 follow-up.

Participant one continued to report experiences of muscle spasm that she believed to be related to persisting damage, and therefore maintained a cautious, protective movement and postural pattern.

"To me, it's just that I've got, I've done some damage there... And to just do the normal things, I'm at a disadvantage because my back doesn't like it anymore, and until it's repaired, it's not going to give me less pain." – P1 follow-up

Participant one's experience was a divergent case. While other participants also reported episodes of persistent stiffness, most reported these experiences as fleeting and quickly modifiable using strategies learnt during the intervention:

> "There's been a few times where my back's gone a bit stiff and funny. But work through it the way you guys told me to, stretching and on the bike and all that, and just keep moving and all good." – P2 follow-up

3.2 | Summary of qualitative findings

Together, the qualitative findings highlight a significant reconceptualization of how participants view the relationship between movement, posture and their LBP. At baseline, the participants believed that painful movement and postures were a threat and that they needed to protect their perceived damaged back. While at follow-up, the participants conceptualized movement and posture (that was relaxed) as a therapeutic recovery strategy, embodying a sense that it was safe to move.

3.3 | Quantitative results

Quantitative findings supported the qualitative findings presented above. Largely, the kinematic and EMG measures of movement and posture and the measures of the psychological factors supported the participants reports, however, there was individual nuance to how this occurred. All quantitative results are presented in the Supporting Information in both table (Table S2) and graphical (Figure S1) form.

3.4 | Integration of findings

Findings of the qualitative and quantitative components for exemplar cases from each qualitative group at follow-up (nonconscious and conscious protection, conscious non-protection and nonconscious non-protection) are integrated using a joint display table (Table 2) (Creswell & Plano Clark, 2011; Fetters & Freshwater, 2015). The comparison between qualitative and quantitative findings highlights how objective biomechanical measures and self-report questionnaires frequently supported participants' perceptions about their movement and postures. Notably, there was significant diversity among participants, both in the baseline and follow-up findings and in the amount of change. For example, Table 2 highlights that some participants movement speed increased, but not their range (P1), while for others, speed did not change, but range did (P5), and for some, both changed (P8). Although P1 reported no overall change in her condition during the follow-up interview, she had a substantial reduction in her pain bothersomeness, increased her bending speed and had considerable improvements in her fear of movement and pain control (Table 2).

3.4.1 | Additional analysis of quantitative differences between qualitative groups

Given that there was some distinction in how participants conceptualized the link between their movement, posture and LBP during the follow-up interview (protection, conscious non-protection or nonconscious non-protection), we explored whether participants who progressed to *nonconscious* non-protection ($n = 7$) had greater improvements in activity limitation, movement and psychological factors than those who remained consciously non-protective ($n = 4$). Graphs suggest a pattern of larger improvements for those participants who progressed to *nonconscious* non-protection than those who remained consciously non-protective (Figure S2). A non-parametric test of difference in ranks of change scores between the *conscious* non-protection and *nonconscious* non-protection groups showed greater changes in pain self-efficacy ($p = 0.042$) and pain catastrophising ($p = 0.042$) in the nonconscious non-protection group. Although some other change scores appeared to be potentially discriminatory between the groups on graphical display, the differences were not significant with the small sample available (TSK-change, $p = 0.109$; BackPAQ-change, $p = 0.230$; and bending speed, $p = 0.171$). Other change scores did not show graphical or statistical evidence for differences between the groups (RMDQ-change, $p = 0.618$; FreBAQ-change, $p = 0.242$; and bending ROM-change, $p = 0.609$).

4 | DISCUSSION AND CONCLUSIONS

4.1 | Key findings

This mixed method study investigated how 12 people with persistent, disabling non-specific LBP conceptualize the relationship between movement, posture and their back pain before and after their rehabilitation journey. Before the CFT intervention, participants reported painful, stiff, tense and restricted movements and postures. They followed traditional postural 'rules' and were careful, protective or avoidant of threatening tasks; patterns corroborated by quantitative measures. After the CFT intervention, most participants described conscious efforts towards less protection during provocative movements and postures that led to improved pain and function. For many, this progressed to automatic, fearless, fluid and normal movements and postures (nonconscious non-protection) with

positive shifts in psychological factors reported qualitatively and observed quantitatively. Overall, the findings demonstrate a re-conceptualisation of movement and posture, from threatening, to therapeutic.

4.2 | Protection as a response to LBP at baseline

4.2.1 | Nonconscious protection

The lived experiences of stiff, restricted, tense movements and postures reported at baseline are consistent with research demonstrating that experimentally induced LBP results in increased back muscle activity, trunk muscle co-contraction, slower and less ROM and increased stiffness (Dubois et al., 2011; Graven-Nielsen et al., 1997). This work highlights that the presence of pain itself results in protective motor responses impacting on movement and posture. Previous systematic reviews have also shown more protective kinematic and EMG features in people with LBP (Geisser et al., 2005; Laird et al., 2014). Additionally, more negative psychological factors (such as pain-related fear, catastrophising or negative LBP beliefs) have been associated with more protective movement behaviours (Christe, Crombez, et al., 2021), even in those without LBP (Knechtle et al., 2021), supporting the presence of a close mind–body relationship.

4.2.2 | Conscious protection

The strong protective movement and postural beliefs (e.g. 'keep your back straight', 'be careful', 'brace your core') reported in this study are common among people with LBP (Darlow et al., 2015), healthcare professionals (Darlow, 2016; Nolan et al., 2019) and society (Darlow, Perry, Stanley, et al., 2014; Nolan et al., 2021). Similarly, the underlying belief that pain represents further damage is also common among people with persistent pain (Bunzli, Smith, Watkins, et al., 2015; Setchell et al., 2017). As well as protection, conscious avoidance was also a commonly reported coping strategy, congruent with previous studies (Bunzli et al., 2017; Darlow et al., 2015). These negative beliefs and protective behaviours commonly originate from treating clinicians (Christe, Nzamba, et al., 2021; Setchell et al., 2017).

Despite protective or avoidance strategies, participants still had high levels of pain and disability at baseline, suggesting they were largely ineffective strategies. Interestingly, all participants described insights at baseline where more relaxed, less protective postures actually reduced their pain. To our knowledge, this discrepancy between a person's belief and behavioural response to pain (*'more protective posture is important to protect my back'*) and their personal experience (*'I experience less pain when relaxed'*) has not been documented before. It highlights the powerful role that beliefs coupled with clinician advice has on behaviour, even when contradicted by experience. This dissonance raises further questions about the iatrogenic contribution to LBP-related disability (Lin et al., 2013; Loeser & Sullivan, 1995).

The concept that pain may result in both nonconscious and conscious protective responses, reinforced or amplified by negative pain-related cognitions and emotions, is consistent with a contemporary understanding of pain (Brodal, 2017). While negative pain-related cognitions and emotions appeared to play an important role in our study, a previous meta-analysis found consistent but only weak associations between negative psychological factors and protective movement (Christe, Crombez, et al., 2021). It may be that individualized assessment of psychological factors, movements and postures in our study accounts for some of this difference.

4.3 | Follow-up post-CFT intervention

During the follow-up interviews after the 12-week CFT intervention, nearly all (11/12) participants described how important (and, often, surprisingly effective) 'less protective' strategies were in reducing pain. The dominant movement and postural narratives during follow-up were that rather than worrying about, protecting or avoiding movements and postures, the participants now felt they could reduce their pain by being 'less protective' during threatening activities such as bending, lifting, sitting or standing. In this way, non-protective movements and postures became therapeutic rather than a threat. This shift is consistent with the goals of CFT which uses behavioural experiments that explicitly trains non-protection during painful, feared or avoided tasks in an effort to reduce or control pain and build self-efficacy (O'Sullivan et al., 2018).

4.3.1 | Persistent protection prevailed

For one participant (P1), there was no sustained or meaningful change to her presentation. Unlike the rest of the participants, P1 did not report strong experiences of pain control generalized into her everyday life. She retained damage beliefs, lacked a sense of independence, and did not have helpful pain control strategies; all factors identified as important for recovery by previous qualitative

literature (Bunzli, McEvoy, et al., 2016; Holopainen et al., 2020; Toye et al., 2021). In the context of our research question, she did not report experiencing pain-relieving 'supple', 'free' and 'relaxed' movements after treatment, important aspects of recovery in people with LBP (Hush et al., 2009; Pugh & Williams, 2014).

4.3.2 | Conscious non-protection

Like our findings, learning to consciously move in more relaxed and efficient ways has been reported as important for people that improve from persistent LBP (Pugh & Williams, 2014). Similarly, reconceptualising pain as; not equalling damage, being multifactorial and retrainable, have previously been reported as important in people recovered from persistent pain (Bunzli, McEvoy, et al., 2016; Leake et al., 2021). Our frequent kinematic and EMG findings of faster, greater amplitude (ROM) and more relaxed movements are congruent with changes towards less protective movements related to improved LBP in two previous systematic reviews (Wernli, Tan, et al., 2020; Wernli et al., 2021).

4.3.3 | Nonconscious non-protection

Seven participants reported progressing to automatic, habitual, fearless and more normal postures and movement patterns. Faster, greater amplitude (ROM) and more relaxed spinal movements and postures (resembling movement of people without LBP [Geisser et al., 2005; Laird et al., 2019]) were also commonly observed. The reports of participants transitioning towards a care-free and non-protective state share similarities to the concept behind the 'forgotten joint scale', which asserts that a normal healthy joint demands no awareness (Behrend et al., 2012).

That changes in pain self-efficacy and pain catastrophising distinguished between the conscious and nonconscious non-protection groups highlights their potential importance in the progression to nonconscious non-protection. Further, it provides a form of validation for the qualitatively derived groups and supports the potential importance of these factors in LBP recovery as identified previously (Lee et al., 2017; Mansell et al., 2017; Smeets et al., 2006).

Together, these findings support an interplay between less protective movements and postures, positive mindset shift, reduced fear and emotional distress, and improved LBP. Given the multidimensional nature of the CFT intervention, the directional nature of these factors remains unclear. Caneiro et al. (2019) previously reported that changes in cognitive and emotional factors appear to coincide with changes in LBP-related disability and proposed the concept of a shift in the entire pain 'schema'. Our findings suggest that movement and posture may form part of this schema for people with LBP.

4.4 | Study considerations

The design of this study limits abilities to make causal inferences about mechanisms and mediators of outcome. Additionally, the design precluded further purposive sampling of participants like P1 who did not change. Nevertheless, reaching codebook saturation after seven participants, with the following five participants confirming the codebook, strengthens the study's validity (Fusch & Ness, 2015). The findings reflect how these 12 individuals conceptualized relationships between movement, posture and LBP and alternative interpretations may exist. Through prolonged engagement, frequent reflexivity, searching for negative cases, peer review analysis, thick description and reaching data saturation, we believe we have described meaningful, representative findings (Shenton, 2004). As the study only involved 12 people with BMIs less than 30, clinicians should consider the profile of their clinical population when considering transferability. The potential for desirability bias should also be considered. Additionally, different designs (such as RCTs with mediation analyses) and larger cohorts utilizing individualized measures and interventions would prove helpful in answering causal questions.

4.5 | Study conclusions

The findings from this mixed methods study offer a framework for understanding how people conceptualize the relationship between movement, posture and low back pain before and after recovery. Baseline interviews and quantitative measures of movement, posture and psychological factors identified the embodiment of conscious and nonconscious protective behaviours intertwined with beliefs of damage, 'good' posture rules, pain-related fear, emotional distress and uncertainty—a 'protect your damaged back' schema. Follow-up interviews and quantitative measures highlighted that when participants consciously became less protective in their postures and movement patterns, they experienced reduced pain and confidence with movement and loading their back. When accompanied by person-centred education, these powerful experiences questioned their previously held damage beliefs and brought hope and confidence. Many participants returned to an automatic, habitual nonconscious non-protective pattern—the embodiment of an 'it's safe to move' schema.

Overall, movement and posture were reconceptualised as a therapeutic recovery strategy, rather than a threatening activity.

AUTHOR CONTRIBUTIONS

KW, AS, AC, PK and POS contributed to the conception and design of the study. KW performed data collection with input from PK, AC, PO and AS. KW and FC led the data analysis with input from all authors. KW prepared the draft manuscript. All authors discussed the results and commented on the manuscript.

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CONFLICTS OF INTEREST

POS receives speaker fees for lectures and workshops on the biopsychosocial management of pain. The authors certify that they have no other affiliations with, financial involvement or conflicts of interest in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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