Cohort profile: Why do people keep hurting their back?

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Research note

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Abstract

Objective Low back pain (LBP) is one of the most disabling and costly conditions worldwide. It remains unclear why many individuals experience persistent and recurrent symptoms after an acute episode whereas others do not. A longitudinal cohort study was established to address this problem. We aimed to; (1) evaluate whether promising and potentially modifiable biological, psychological, social and behavioural factors, along with their possible interactions, predict LBP outcome after an acute episode; (2) compare these factors between individuals with and without acute LBP; and (3) evaluate the time-course of changes in these factors from LBP onset. This paper outlines the methodology and compares baseline characteristics between acute LBP and control, and LBP participants with and without follow-up.

Results 133 individuals with acute LBP and 74 pain-free individuals participated. Bio-psycho-social and behavioural measures were collected at baseline and 3-monthly for 12 months (LBP) or 3 months (control). Pain and disability were recorded fortnightly. Baseline characteristics were mostly similar between those who did and did not return for follow-up. Initial analyses of this cohort have revealed important insights into the pathways involved in acute-to-chronic LBP. These and future findings will provide new targets for treatment and prevention of persistent and recurrent LBP.

Introduction

Low back pain (LBP) is the world's leading cause of disability [1]. The lifetime (70–90%) and point (~ 10%) prevalence of LBP [2, 3] makes it a leading reason for physician visits, hospitalisations, health/social care service utilisation [4] and work-related absences [5], placing an enormous and escalating economic burden on healthcare systems and society [6]. Most of this burden is attributed to the condition when LBP becomes persistent or recurrent. Why some individuals with acute LBP recover, whereas others do not [7, 8], is largely unknown.

Although psychosocial factors have generally been considered stronger predictors of long-term outcome than diagnostic or injury-related factors [9, 10], they only explain a small proportion of the variance in outcome [10, 11]. Biological factors have largely been dismissed and the few that have been comprehensively addressed (e.g., muscle strength and endurance, range of motion [12]) have little relation to outcome [13]. With this incomplete understanding of factors related to LBP outcome, it is not surprising that most treatments have modest effects at best [14] and are generally unable to prevent recurrence/persistence of pain [15].

We argue that three issues underlie a fresh approach to this problem. First, biological factors that could plausibly contribute to LBP outcome have been identified in cross-sectional studies but have not been tested longitudinally from the initial onset of symptoms. Second, although interaction between biological, psychological and social factors is implied in the biopsychosocial model of pain, this interaction has received little attention in longitudinal studies of LBP outcome. Third, there is growing evidence that behavioural factors such as sleep interact with the "biopsychosocial" components of LBP, but their contribution to outcome is unknown. Further, little is known of the time course of changes in each of the biopsychosocial domains over 12 months following an acute LBP episode. There is strong foundation to evaluate whether candidate biological factors, along with their possible interaction with psychosocial factors, contribute to the transition from acute LBP to that of persistent/recurrent symptoms.

The purpose of this paper is to provide a profile of a cohort study that aims to; (1) evaluate whether outcome after an acute episode of LBP can be predicted by the most promising bio-psycho-social factors and/or the interactions between them; (2) compare these factors between individuals with and without acute LBP; and (3) evaluate the time course of changes in these factors following LBP onset. This paper outlines the participants, measures and data collection schedule, and compares baseline characteristics between acute LBP and control, and follow-up and non-follow-up LBP participants.

Methods

Study design

This longitudinal cohort study involved measures of variables within the biological, psychological and social domains (Table 1) at multiple time-points for 12 months (Additional file 1: Table S1). Measures of sleep, physical activity, alcohol consumption and smoking were grouped separately in a "behavioural" domain as they cross between classical domains. Potential participants were screened according to inclusion/exclusion criteria (Additional file 2: Table S2) to determine eligibility as either a control or LBP participant. Those who met the criteria completed a series of detailed online questionnaires related to their pain and disability level, health, demographics, behaviour, and psychosocial status. After confirmation that participants met the inclusion criteria for pain and disability (see below) they proceeded with a laboratory-based assessment session within 24 hours. This involved ~ 4 hours of biological measurements within a laboratory at the University of Queensland. Measures (laboratory-based biological measures and online questionnaires) were repeated at 3, 6 and 9 months for LBP participants, and at 3 months for control participants. At 12 months, questionnaires were completed by all participants in the LBP group in addition to a separate 12-month recall questionnaire relating to the trajectory of their LBP since initial assessment for the study. Participants also reported their pain and disability level every fortnight for 3 (controls) or 12 months (LBP).

Table 1
Detailed description of measures.

Measure	Description	Units/range
Demographic, health & function:		
Age, height, weight, sex	Self-reported age, height, weight and sex.	Years, cm, kg, male/female
BMI	Weight (kg) divided by the squared height (cm).	Numerical
Co-morbidities	Self-selected disease(s)/condition(s) other than LBP from a list (including "other").	Yes/no, type
Previous LBP	Self-reported previous incidence(s) of LBP not including the current (study entry) episode.	Yes/no
Health care/medication usage	Self-reported health care and medication frequency of use and type for LBP	Yes/no, frequency, type
Low-Back Outcome Scale (LBOS [16], *measured in LBP only*)	Questionnaire: evaluates pain and physical function. Consists of 13 differently weighted items that assess current pain, function (e.g., employment, domestic chores and sport activities), and the frequency of use of medical treatments/consultations and analgesics with respect to the respondent's LBP.	0–75: ↑score = ↑function, 0–29 = poor, 30–49 = fair, 50–64 = good, ≥ 65 = excellent
Psychological:		
Centre for Epidemiological Studies of Depression Scale (CES-D [17])	Questionnaire: evaluates depressive symptoms. Consists of 20 items. Respondents' rate how often over the past week they experienced symptoms associated with depression using a four-point Likert scale ranging from 0 ("rarely or none of the time") to 3 ("most or all of the time").	0–60: ↑score = ↑depressive symptoms, > 15 = clinically significant depressive symptoms
Pain catastrophizing scale (PCS [18])	Questionnaire: evaluates thoughts and feelings related to pain suggestive of catastrophic cognitions. Consists of 13 items. Responses to questions are quantified on a five-point Likert scale ranging from 0 ("not at all") to 4 ("all the time") with respect to how often the respondent experiences certain thoughts and feelings when in pain. Yields a total score as well as three subscale scores of magnification ("I become afraid that the pain will get worse": 3 items), rumination ("I worry all the time whether the pain will end": 4 items) and helplessness ("I feel I can't go on": 6 items).	0–52: ↑score = ↑pain catastrophizing Subscales: magnification (0–12), rumination (0–16) helplessness (0–24)
Fear-Avoidance Beliefs Questionnaire (FABQ [19], *measured in LBP only*)	Questionnaire: evaluates fearful and avoidant behaviours. Consists of 16 items in which participants' rate their agreement with each statement on a seven-point Likert scale ranging from 0 ("completely disagree") to 7 ("completely agree"). Two subscales measure the agreement of statements related to physical activity (FABQ-PA: 4 items) and work (FABQ-W: 7 items).	0–96: ↑score = fear-avoidance beliefs Subscales: FABQ-PA (0–24), FABQ-W (0–42)
Pain Self-Efficacy Questionnaire (PSEQ [20], *measured in LBP only*)	Questionnaire: evaluates the confidence individuals have in performing activities while in pain. Consists of 10 items. Respondents' rate how confidently they can perform a range of activities using a seven-point Likert scale.	0–60: ↑score = ↑self-efficacy beliefs
Social:		
Education level	Self-selected education level (e.g., school certificate, bachelor/postgraduate degree, etc.) from a list.	Type
Marital status	Self-selected marital status (e.g., never/currently married, separated, cohabitating, etc.) from a list.	Type
Type of work	Self-selected primary occupation (e.g., professional, technician, clerk, etc.) in the last 12 months from a list.	Type
Job satisfaction	Self-reported job satisfaction using a seven-point NRS ranging from "extremely dissatisfied" to "extremely satisfied"	0–6: ↑score = ↑job satisfaction
Job Content Questionnaire (JCQ [21])	Questionnaire: evaluates psychosocial demands resulting from the respondent's job. Consists of 26 items re-grouped into several dimensions. Responses to each item are quantified on a four-point Likert scale from 1 ("totally disagree") to 4 ("totally agree").	Job skill discretion (12–48, ↑score = ↑discretion), job decision-making authority (12–48, ↑score = ↑authority), job demands (12–48, ↑score = ↑demands), job decision latitude (12–48, ↑score = ↑latitude), co-worker support (4–16, ↑score = ↑support), supervisor support (4–16, ↑score = ↑support), job insecurity (3–14, ↑score = ↑insecurity)

TNF – tumor necrosis factor; IL-6 – interleukin-6; IL-1β – interleukin-1β; CRP – C-reactive protein; PPT – pressure pain threshold; CPT – cold pain threshold; HPT – heat pain threshold; CPM – conditioned pain modulation; TS – test stimulus; CS – conditioning stimulus; EMG – electromyography; CoP – centre of pressure.

Measure	Description	Units/range
Sick days over last 12 months	Self-reported number of sick-days taken from work over the previous 12 months.	Numerical
Reason(s) for not working	Self-selected reason(s) for not working for pay (e.g., caring for family, studies/training, ill health, etc.) from a list.	Yes/no, type
Impending compensation	Self-reported impending compensation associated with the participants' LBP.	Yes/no
Biological:		
Systemic inflammation	Laboratory measure: Serum concentrations of TNF, IL-6, IL-1β and CRP. Venous blood was drawn, clotted (30 min, room temperature), and serum was separated by centrifugation (2500 rpm, 15 min) before storing at − 80 °C. Concentrations of each biomarker were determined in duplicate using "high sensitive" (assay sensitivity: CRP = 0.022 ng/ml, IL-6 = 0.110 pg/ml, IL-1β = 0.14 pg/ml, TNF = 0.191 pg/ml) enzyme-linked immunosorbent assays (ELISA, R&D Systems, Minneapolis, MN). Zero was allocated for values below the reported sensitivity of the test [22, 23].	TNF (pg/ml), IL-6 (pg/ml), IL-1β (pg/ml), CRP (ng/ml)
Pain processing	Laboratory measure: Pain thresholds to pressure (PPT), heat (HPT) and cold (CPT) were assessed at the back (LBP – site of most pain on palpation; control – fixed site ~ 5 cm rostral [toward the head] and lateral to the center of the lumbo-sacral junction divided randomly between the left and right side) and either the thumb nail bed (PPT) or proximal volar aspect of the forearm (HPT and CPT) [24, 25]. CPM was assessed based on our previous work [26] that validated the use of PPT as a test stimulus (TS) and noxious contact heat as the conditioning stimulus (CS). TS and CS were applied to the lower back or forearm. CPM was measured on three occasions (separated by a 15-minute break) using different anatomical locations and stimuli (TS/CS) arrangements as reported previously [24, 25]. The CPM response was calculated as the difference between the TS scores obtained before and during the CS. A higher TS score during the CS than baseline indicated pain inhibition (expressed as a positive value). A lower TS score during the CS than baseline indicated pain facilitation (negative value).	PPT (kPa, ↑score = ↑pain threshold), HPT (°C, ↑score = ↑pain threshold), CPT (°C, ↑score = ↓pain threshold), CPM (kPa, > 0 = pain inhibition, < 0 = pain facilitation)
Multifidus muscle morphology	Laboratory measure: Multifidus muscle cross sectional area was measured at the level of each spinous process between the first lumbar (L1) and first sacral (S1) vertebra on both sides of the body (totalling 12 images) using a high resolution ultrasound system (LOGIC 9; GE Company, Milwaukee, WI), with a linear array 10 MHz transducer [27].	Cross-sectional area (cm^2)
Trunk muscle coordination	Laboratory measure: Latency of response of superficial trunk muscle activity to unloading was assessed using an established paradigm [28]. Participants sat in a semi-sitting position with their pelvis fixed and a cable attached either behind or in front of their trunk via a harness. On instruction, participants pulled against the cable with a force of 12.5% of their body weight using visual feedback (target on a computer screen). The cable was released at an unpredictable time for 10 repetitions in each direction and the response of 12 abdominal and back muscles were recorded with surface EMG electrodes using placement described previously.	Muscle activity (EMG)
Trunk mechanical properties	Laboratory measure: Effective trunk stiffness, mass and damping was estimated following trunk perturbation with the trunk modeled as a linear second-order system [29]. Participants sat in a frame with equal weights (7.5% body weight) attached to the front and back of the trunk via pulleys such that the masses were balanced and the trunk could move freely with minimal muscle activity. The trunk was perturbed by the unexpected release of one of the weights. The task was repeated 10 times in each direction with the order of directions randomised. Trunk kinematics and cable force were used to estimate system properties.	Mass (kg), stiffness (N/m), damping (Ns/m)
Trunk postural control	Laboratory measure: Dynamic trunk control was assessed with participants balancing on a seat with a curved base placed on a force plate to record centre of pressure (CoP) [30]. Participants performed three 30-second trials (separated by a 1 min rest period) with eyes open, eyes closed and with feedback of the seat position in the anteroposterior direction (target on a computer screen). In an additional trial, participants were perturbed by release, at an unexpected time, of a weight (3% body weight) attached behind the trunk. Feedback was provided until the perturbation. Participants were instructed to regain balance as fast as possible three times under four conditions: eyes open, eyes closed, feedback (as above), and feedback up until perturbation induced by release of the weight. Coordinates of CoP were recorded as well as trunk muscle activity (as for trunk muscle coordination) and kinematics using a motion capture system.	Balance (CoP), muscle activity (EMG), kinematics (degrees)
Standing postural control	Laboratory measure: Postural control was measured with participants standing barefoot and blindfolded on a force plate for 75 seconds. To test the effect of disruption of proprioception at the calf and lower back, the task was repeated with vibrators (~ 60 Hz, 1 mm amplitude) attached bilaterally over the Achilles tendon and lumbar paraspinal muscles [31], separately, in random order. Vibrators were switched on for 15 s at ~ 15 s after the start of the trial. Coordinates of CoP were recorded.	Balance (CoP)
Lumbopelvic motion	Laboratory measure: Angular measures of limb movement and lumbopelvic motion were calculated across time during active/passive knee flexion and active/passive hip rotation (both lateral and medial) in prone using a motion capture system [32].	Kinematics (degrees)
Lumbopelvic control during gait	Laboratory measure: Lumbopelvic/trunk kinematics and trunk muscle activity (EMG) was assessed during 3 minutes of treadmill walking at 3 km/h and 5 km/h [33, 34].	Muscle activity (EMG), kinematics (degrees)
Behavioural:		

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Measure	Description	Units/range
Pittsburgh Sleep Quality Index (PSQI [35])	Questionnaire: evaluates sleep duration and quality. Consists of 19 items that cover seven dimensions, including subjective sleep quality, sleep duration and latency (time it takes to fall asleep), and the frequency and severity of specific sleep-related complaints in the previous month. Scores from each dimension (range: 0–3) are individually reported as component scores and summed to derive a sleep quality maximum score.	0–21: ↑score = ↓sleep quality, > 5 = poor sleeper Component scores (all 0–3): duration of sleep, sleep disturbance, sleep latency, day dysfunction due to sleepiness, sleep efficacy, overall sleep quality, sleep medications Sleep hours per night (h)
International Physical Activity Questionnaire (IPAQ [36])	Questionnaire: evaluates health-related physical activity. Consists of seven items that assess four domains of physical activity over the previous week, including vigorous activity (activities that make breathing much harder than normal), moderate activity (activities that make breathing somewhat harder than normal), walking and time spent sitting.	↑score = ↑physical activity (refer to scoring manual for calculating and interpreting MET scores and activity categories)
Alcohol Use Disorders Identification Test (AUDIT [37])	Questionnaire: evaluates alcohol consumption, dependence and drinking-related problems. Consists of 10 items that address four areas: alcohol consumption (quantity and frequency), drinking behaviour and dependence, alcohol related psychological effects and alcohol related problems. Responses to each item are quantified on a five-point Likert scale from 0 to 5.	0–40: ↑score = ↑level of alcohol problem, ≥8 = a hazardous/harmful pattern of alcohol consumption
Past/current smoking status	Self-reported past and current smoking history.	Yes/no, duration, quantity
Fortnightly (for 12 months):		
Pain	Self-reported pain intensity over the last week using an 11-point NRS ranging from “none” to “worst imaginable”.	0–10: ↑score = ↑pain
Roland Morris Disability Questionnaire (RMDQ [38])	Questionnaire: evaluates disability caused by LBP. Involves 24 items associated with physical functions likely to be affected by LBP. An item receives a score of 1 if it is applicable to the respondent or a score of 0 if it is not.	0–24: ↑score = ↑disability
12-month LBP trajectory	Questionnaire: evaluates the trajectory of LBP symptoms over 12 months from study commencement. Consists of a series of questions (asked at 12 months) that address how the respondent’s current LBP compares with their LBP at the start of the study, the frequency and duration at which the responder experienced periods without pain, periods of recurrence/persistence, and/or periods of markedly worse symptoms, based on their 12-month recall. In addition, respondents are asked to classify their LBP experience into one of seven trajectories using visual and word descriptions.	Yes/no, duration, frequency, trajectory type

TNF – tumor necrosis factor; IL-6 – interleukin-6; IL-1β – interleukin-1β; CRP – C-reactive protein; PPT – pressure pain threshold; CPT – cold pain threshold; HPT – heat pain threshold; CPM – conditioned pain modulation; TS – test stimulus; CS – conditioning stimulus; EMG – electromyography; CoP – centre of pressure.

<<Insert Table 1>>

Participant recruitment

From a total of 1849 individuals screened between April 2012 and September 2017, 133 with acute LBP and 74 without pain (controls) met the eligibility criteria for study participation (Fig. 1; Table S2). Participants were recruited through advertisements around the University campus and local community, social media, three nearby hospitals and via a professional recruitment agency (Trialfacts).

Screening was conducted using two different methods. Initially, eligibility was determined via email and/or phone, and when this method was used the reason(s) for exclusion at this initial screening were not recorded. This was replaced with an automated online screening questionnaire from April 2014, with reasons for exclusion recorded. The inclusion and exclusion criteria for LBP participants are outlined in Table S2. Participants did not need to be experiencing their first ever LBP episode. Previous LBP was recorded for inclusion as a covariate. Control participants were included if they had not experienced LBP within the last month in addition to meeting the exclusion criteria in Table S2.

<<Insert Fig. 1>>

At the first laboratory testing session (after initial screening), eligibility for inclusion were confirmed using data from the baseline questionnaire (completed within 24 hours of the test session), to ensure that the participant’s average level of pain and LBP-related disability in the past week exceeded the inclusion threshold (≥ 1/10 for pain; ≥1/24 for disability). Potential control participants who reported a score > 0 on a 0 (“no pain”) to 10 (“worst pain imaginable”) numerical rating scale (NRS) and/or the Roland Morris Disability Questionnaire (RMDQ [38], [for definition of measures see Table 1]), or provided no scores were excluded from the study (N = 14). Potential LBP participants who reported < 1 on the pain NRS and/or the RMDQ, or provided no scores in the past week were excluded from the study (N = 8). After data collection, criteria for exclusion were identified for two participants with LBP (multiple sclerosis [N = 1], duration of LBP > 14 days [N = 1]) and two control participants (no pain/disability data [N = 1], pain/injury in another body region [N = 1]). These participants were excluded from the dataset. The final cohort included 133 and 74 participants in the LBP and control groups, respectively, for analyses.

Classification of LBP participant’s outcome

For some analyses that have been conducted to date, LBP participants have been classified based on their pain (NRS) and disability (RMDQ) status as either "unrecovered", "partially recovered" or "recovered" at 3 and 6 months after their initial assessment session (i.e., baseline). Participants were classified as: (1) *unrecovered* if they had an increase or no change in pain and disability from baseline, or a pain score of ≥ 7 of 10 (corresponding with severe pain [39]), (2) *partially recovered* if their pain and/or disability had decreased from baseline, but was unresolved, or (3) *recovered* if they had no pain and disability at the corresponding follow-up time-point. Pain and disability status at each 3-month time-point was calculated by averaging the available data from the final three fortnightly pain NRS and RMDQ scores of the last month prior to that time-point (e.g., 6 months: weeks 20, 22, 24). Participants were classified if pain and disability data were available for at least one of the three fortnightly time-points. Alternative methods for classification of outcome could be applied to the data for future analyses.

Measurements

Details of the measures and at what time-point(s) they were implemented are presented in Tables 1 and S2. All variables were measured in a standardised order for each participant. Biological measures were those we considered to be the most promising candidate factors for predicting LBP recurrence/persistence based on previous research and plausible rationales founded on clinical, epidemiological and fundamental research. For psychological measures, we considered three key domains of relevance in LBP: cognitive (expectations, beliefs, and perceptions concerning pain) [10, 40–42], emotional (distress, anxiety, and depression) [9], and behavioural (coping, pain behaviour, and activity/activity avoidance) [10, 40, 41]. Social measures were selected based on the Multinational Musculoskeletal Inception Cohort Study (MMICS) guidelines [43]. These guidelines were developed by an international expert team with review of the best available evidence from systematic reviews, narrative reviews and expert consensus. As it was not our intention to withhold treatment over the study period, we collected information regarding health care and medication use so that treatment variables can be included as covariates. The total number of variables was restricted to limit the required participant sample size, minimise the potential for over-fitting, and for the cost-benefit of the study.

Results

Participant characteristics at baseline

The characteristics of the study participants are described in Additional file 3: Table S3. LBP and control participants were of similar age and sex, but LBP participants were taller, heavier, had a greater BMI, greater prevalence of comorbidities, and greater incidence of previous LBP than controls.

Participant attrition

Of the 133 eligible acute LBP participants who were enrolled in the study and provided baseline data, 35 (26%) were lost to follow-up for their laboratory-based measures at 3 months, a further 9 at 6 months (total lost to follow-up = 44, 33%), and a further 5 at 9 months (total lost to follow-up = 49, 37%). All participants were invited to complete a questionnaire at 12 months, irrespective of whether or not they had continued or dropped out. This was completed by all but 41 of the LBP participants (N = 92: 74 follow-up, 18 drop out participants). Ten control participants did not return for follow-up at 3 months. With respect to the completion rate of fortnightly pain (NRS) and disability (RMDQ) questionnaires, 85% (1505 of 1770) were completed by LBP participants who were retained for follow-up (i.e., up to 3, 6, 9 or 12 month) within 7 days of each questionnaire being issued, and 91% (282 of 310) were completed by control participants (i.e., up to 3 months).

Comparison of follow-up and non-follow-up participants

Comparison of baseline characteristics between LBP participants who did and did not follow-up for laboratory-based measures at 3, 6 and 9 months, and questionnaire measures at 12 months, revealed some differences (Table 2). Participants lost to follow-up at 3 months had higher pain (NRS, $P = 0.019$) and lower function (Low-Back Outcome Scale [LBOS], $P = 0.012$) at baseline than those who remained in the study. Baseline function was also lower in participants lost to follow-up at 6 months ($P = 0.048$), and baseline medication use was higher in those lost to follow-up at 12 months ($P = 0.040$) than participants who did return for follow-up at those time-points. There were no baseline differences between participants who did and did not follow up at 9-months. Baseline characteristics did not differ between control participants who did and did not follow up at 3 months ($P > 0.05$).

Table 2
Comparison of baseline characteristics between participants with LBP who did (FU) and did not (NFU) follow-up at 3, 6, 9 and 12 months.

	3 months			6 months			9 months			12 months		
	Summary statistics			Summary statistics			Summary statistics			Summary statistics		
Characteristic	FU (N = 98)	NFU (N = 35)	P-value	FU (N = 89)	NFU (N = 44)	P-value	FU (N = 84)	NFU (N = 49)	P-value	FU (N = 92)	NFU (N = 41)	P-v
Age (years)‡	28 (22–34)	24 (20–32)	0.074	27 (22–34)	26.5 (20.5–33.5)	0.362	27.5 (22.5–34)	25 (21–34)	0.264	27 (22.5–35)	25 (20–31)	
Height (m)†	1.73 (0.09)	1.70 (0.09)	0.078	1.73 (0.09)	1.71 (0.09)	0.173	1.73 (0.09)	1.72 (0.09)	0.615	1.73 (0.09)	1.71 (0.09)	
Weight (kg)‡	73 (63–82)	72 (56–85)	0.746	73 (62–82)	73.5 (60.5–84.5)	0.815	72.5 (62.5–82.5)	74 (61–84)	0.744	71.5 (60.5–81.5)	75 (62–85)	
BMI (kg/m^2)‡	24.0 (21.4–26.3)	25.2 (21.0-27.7)	0.409	24.0 (21.4–26.3)	24.1 (21.7–27.5)	0.449	24.0 (21.8–26.3)	23.9 (21.1–27.2)	0.961	23.9 (21.4–26.1)	25.9 (21.2–27.4)	
Sex (% female)	48.0	62.9	0.130	49.4	56.8	0.423	50.0	55.1	0.570	51.1	53.7	
Pain (NRS)‡	5 (3–6)	6 (5–7)	**0.019**	5 (3–6)	6 (4–7)	0.078	5 (3–7)	5 (4–7)	0.506	5 (3-6.5)	6 (4–7)	
Disability (RMDQ)‡	6 (3–9)	7 (4–11)	0.140	6 (3–9)	6.5 (4-10.5)	0.293	6 (4–9)	6 (4–10)	0.613	6 (4–9)	7 (4–10)	
Function (LBOS)†	48.4 (11.2)	42.7 (10.8)	**0.012**	48.3 (10.7)	44.1 (12.2)	**0.048**	48.2 (10.5)	44.6 (12.4)	0.077	48.1 (11.0)	44.1 (11.7)	
Previous LBP (% yes)	92.9	88.6	0.429	92.1	90.9	0.809	91.7	91.8	0.973	92.4	90.2	
Comorbidity (% yes)	41.8	54.3	0.204	42.7	50.0	0.426	40.5	53.1	0.159	0.5	41.5	
Healthcare utilization (% yes)	18.4	23.5	0.514	20.2	18.6	0.826	21.4	16.7	0.508	19.6	20.0	
Medication utilization (% yes)	18.8	32.1	0.152	21.1	25.0	0.650	19.7	26.8	0.390	16.7	34.3	

Baseline variable (characteristic) summary statistics (mean [SD]†, median [IQR]‡ or percentage) compared between low back pain (LBP) participants who did and did not follow-up (NFU), separately at 3, 6, 9 (for laboratory-based measures) and 12 (questionnaire measures) month time-points using *t* tests (continuo data, normally distributed), Mann-Whitney *U* tests (continuous data, not normally distributed) or Chi squared tests (categorical data).

<<Insert Table 2>>

Discussion

This paper profiles the only acute LBP cohort in which detailed biological, psychological, social and behavioural factors have been longitudinally and frequently collected, to date. The cohort has great potential to provide unique insight into the features that may predict and/or mediate long-term outcome [44].

The findings of baseline (acute LBP) characteristics presented here provide a foundation for future longitudinal analyses. Despite the rate of loss to follow-up, most occurred after the first session, and baseline characteristics were mostly similar between those who did and not return for follow-up.

Initial analyses of this cohort have revealed specific immune and nervous system features associated with the transition to persistent/recurrent LBP, and that various psychological and behavioural factors shape these relationships [22–25, 45]. Ongoing analyses focus on elucidating the role of trunk neuromuscular, kinematic, mechanical and morphological properties, along with their possible interactions with psychosocial/behavioural features, in predicting LBP outcome.

Limitations

- The strict “acute LBP criteria”, including the inclusion of individuals within 2 weeks of onset of a LBP episode (following 1 month without pain) rendered recruitment challenging. More than 50% of screened individuals were ineligible to participate because their LBP did not meet these criteria.

- Study measures (four ~ 4-hour laboratory-based testing sessions) and follow-up procedures imposed substantial burden and explains the reported attrition.
- As it was not possible to schedule laboratory sessions at a standardised time, blood samples were collected at different times during the day for each participant. This is important because cytokines exhibit diurnal variations [46]. To account for this issue, time of blood collection was recorded for inclusion as a potential confounding factor when interpreting cytokine levels.

Abbreviations

AUDIT
Alcohol Use Disorders Identification Test; BMI:body mass index; CES-D:Centre for Epidemiological Studies of Depression Scale; CoP:centre of pressure; CPM:conditioned pain modulation; CPT:cold pain threshold; CRP:C-reactive protein; CS:conditioning stimulus; ELISA:enzyme-linked immunosorbent assays; EMG:electromyography; FABQ:Fear-Avoidance Beliefs Questionnaire; FU:follow-up participants; HPT:heat pain threshold; IPAQ:International Physical Activity Questionnaire; IQR:interquartile range; JCQ:Job Content Questionnaire; IL-1β:interleukin-1β; IL-6:interleukin-6; LBOS:Low-Back Outcome Scale; LBP:low back pain; NFU:non-follow-up participants; NRS:numerical rating scale; PCS:Pain Catastrophizing Scale; PPT:pressure pain threshold; PSEQ:Pain Self-Efficacy Questionnaire; PSQI:Pittsburgh Sleep Quality Index; RMDQ:Roland Morris Disability Questionnaire; SD:standard deviation; TNF:tumor necrosis factor; TS:test stimulus.

Declarations

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

All data are held at The University of Queensland, Brisbane, Australia, and handled confidentially in a de-identified format. Currently, only the research team has access to the data. Proposals for collaborative analyses are invited to contact the lead author Dr David Klyne: d.klyne@uq.edu.au or principal investigator (Professor Paul Hodges: p.hodges@uq.edu.au).

Consent for publication

Not applicable.

Ethics approval and consent to participate

The study was approved by The University of Queensland's Human Research Ethics Committee (ID: 2010000045), Royal Brisbane & Women's Hospital Human Research Ethics Committee (ID: HREC/13/QRBW/268), and the Uniting Care Health Human Research Ethics Committee (ID: 1404). All participants provided written informed consent, were informed of their right to withdraw from the study at any time without penalty, and were informed of the study purpose.

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Author's contributions

Conceived and designed the study: DK, PH, WVDH, MB, JC, AK, LM, MN and MS. Recruitment of participants: DK, LO, RP and GR. Analysed the data: DK, PH, WVDH and RM. Wrote the manuscript: DK and PH. All authors revised the manuscript and approved the final version.

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Figures

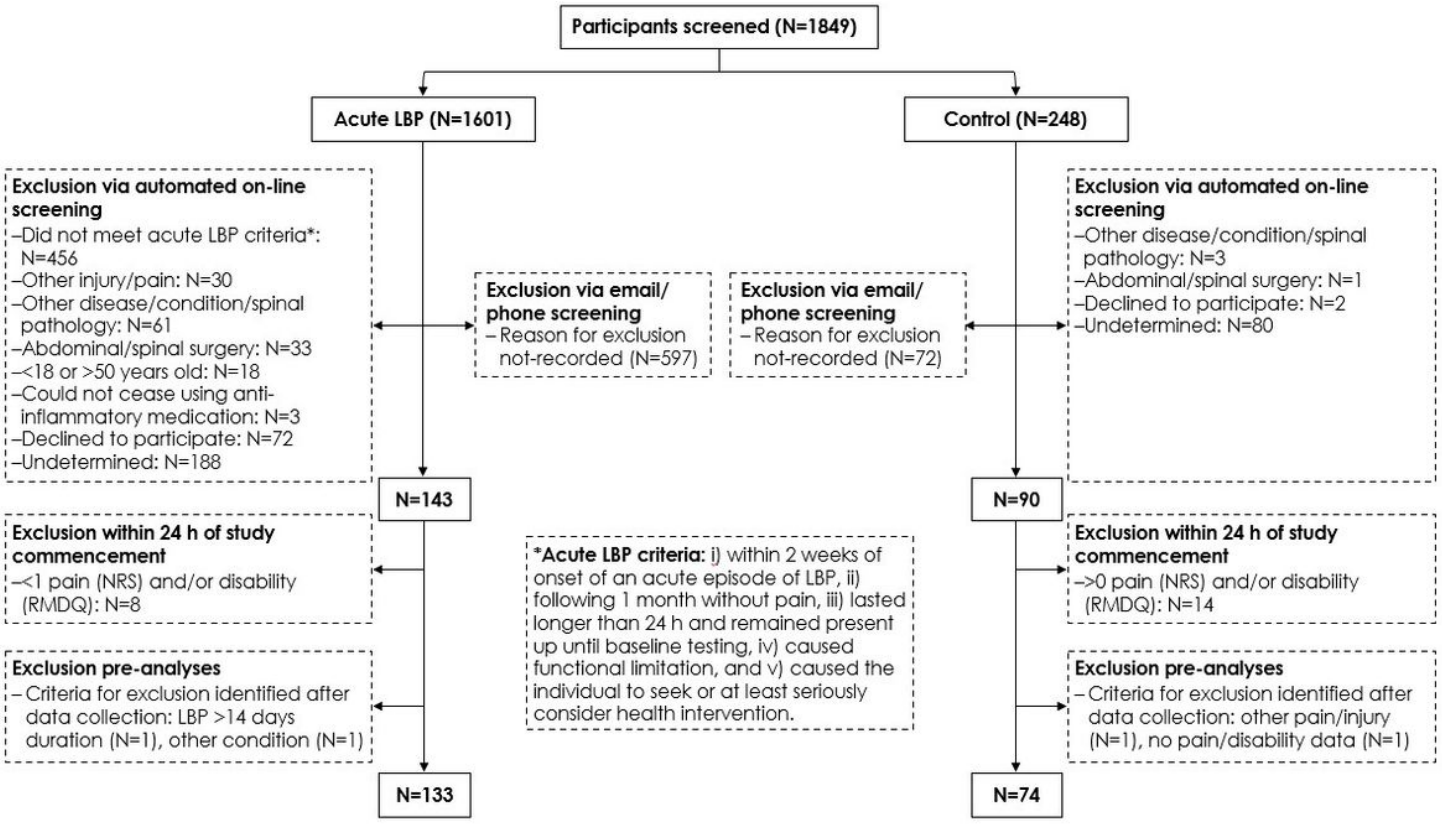

Figure 1

Cohort flow diagram.

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