

# BMJ Open What triggers an episode of acute low back pain? A protocol of a replication case-crossover study

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## ABSTRACT

**Objective** To describe all the procedures of a study that will replicate a previous case-crossover study investigating physical and psychosocial transient exposure risk factors for triggering an episode of acute non-specific low back pain (LBP) at emergency departments in an emerging country.

**Methods** This case-crossover study will recruit 350 patients, aged between 18 and 80 years, with a new episode of acute non-specific LBP seeking care at emergency departments from public hospitals in Brazil. We will collect information about exposure to a range of physical (eg, awkward postures, lifting children or animals, vigorous physical activity) and psychosocial triggers (eg, distraction, tiredness, alcohol consumption) that were examined in the previous study. The exposure to each trigger during the 2 hours preceding the onset of LBP (case window) will be compared with exposure in the 2-hour periods ending 24 (24–26 hours) and 48 (48–50 hours) hours before the onset of back pain (control window). Conditional logistic regression models will be built to estimate ORs expressing the magnitude of increased risk of developing LBP associated with each factor.

**Discussion** This study will enable the confirmation of previous findings regarding transient exposure to factors that increase risk for an episode of acute LBP in a different setting (at emergency departments of an emerging country). To minimise the potential for recall bias, the maximum time between episode onset and interview will be 7 days; we will encourage participants to use their smartphones and diaries to remember the investigated period. Also, our interview script asked participants to nominate the key aspects of each day. Despite these efforts, the retrospective study design means it is not possible to completely exclude potential for recall bias. Furthermore, participants will be blinded to the case and control periods.

**Ethics and dissemination** Ethics were granted by the Research Ethics Committee (#20310219.8.0000.0064). Study findings will be disseminated through publications and conference presentations.

## BACKGROUND

It is estimated that about 540 million people suffer from low back pain (LBP) worldwide.<sup>1</sup> LBP is the leading cause of years lived with

## Strengths and limitations of this study

- This replication study will be conducted in emergency departments that better represent the target population.
- The findings of the study could confirm and provide better information about brief exposure to a range of modifiable physical and psychosocial risk factors.
- The case-crossover design addresses some of the important limitations of previous studies investigating the risk factors of low back pain.
- Despite the efforts to minimise the potential for recall bias, this issue cannot be ruled out.

disability.<sup>1</sup> There is no convincing evidence to support a definitive cause for non-specific LBP. Despite that, studies have shown that non-specific LBP can be influenced by several factors.<sup>2</sup> Understanding the factors that increase the risk of developing a new episode of LBP is critical for the development of effective prevention strategies.

Previous research on risk factors has focused on factors involving long-term exposure (eg, smoking, body mass index (BMI)) and non-modifiable factors (eg, gender, age) for the development of a new episode of LBP.<sup>3</sup> In contrast, recent studies have concluded that transient exposure to modifiable risk factors (eg, exposure to awkward position, manual tasks with load or psychological stress) may substantially increase the risk of developing a new episode of LBP.<sup>2,3</sup> Modifiable risk factors with transient exposure are usually identified immediately before the onset of the symptoms.<sup>4</sup> Understanding and controlling exposure to these risk factors may be extremely important in preventing new episodes of LBP.

The case-crossover design allows quantification of the increased risk associated with transient exposure to the variable under study.<sup>5</sup> This research design has many advantages compared with traditional case-control

studies. In case-crossover studies, the individual plays the role of being his or her own control, thus eliminating the effects of between-person confounders such as genetics and confounders that remain constant over time (ie, within-person characteristics that do not change or vary over time).<sup>2,4</sup> The general principle of this type of study is to find an answer to the question, ‘Was the individual doing something unusual right before the onset of the illness/ injury/ symptom that may have triggered it?’

Three previous studies<sup>2,6,7</sup> investigated transient risk factors for LBP using a case-crossover design. The first study<sup>7</sup> is a Danish longitudinal case-crossover study that included 157 home care workers and nursing aides working in residential homes and home care for elderly or handicapped people. The outcome of pain onset was collected through a pain diary, and work-related risk factors were collected weekly. Data were collected six times with intervals of approximately 3 months. The main finding of this study<sup>7</sup> was that psychosocial and physical strain on one workday does not predict LBP onset in the following day. Although this was a prospective study, the outcome of LBP onset was a measure of pain increase that did not presuppose the participant to be pain free at the outset. The second study<sup>6</sup> was conducted in the USA and included adults with LBP of less than 3 months’ duration. Also, it required daily internet access, a valid email address and basic computer literacy. Participants completed internet-based serial assessments at both 3-day and 7-day intervals for 6 weeks about specific physical activity exposures or psychological triggers over the past 24 hours. Prolonged sitting (>6 hours) was significantly associated with flare-ups (OR 4.4, 95% CI 2.0 to 9.7;  $p<0.00$ ), and stress or depression was also significantly associated (OR 2.5, 95% CI 1.0 to 6.0;  $p=0.04$ ).<sup>6</sup> Although this was a prospective study, the outcome was LBP flare-up. Finally, the third study<sup>2</sup> conducted in Australia recruited 999 adults with a new episode of acute LBP, presenting to primary care within 7 days from pain onset and reporting pain of at least moderate intensity in the first 24 hours of the current episode. Each participant was asked to report exposure to 12 putative triggers over the 96 hours preceding the onset of back pain. Despite the retrospective case-crossover design, the outcome was a new LBP onset, and the mean time between the episode onset and study interview was only 5 days.

To date, the results of the three studies<sup>2,6,7</sup> have not been confirmed because none have undergone replication

testing. The replication method is essential to confirm previous findings and, in this case, help future researchers use more reliable information for the development of effective prevention strategies.<sup>8</sup> It is known that research on risk factors for LBP can present a great heterogeneity due to variations in the research methods, definitions used and population investigated.<sup>9</sup> This study protocol therefore aims to describe all the procedures of a study which will identify the risk of transient exposure to physical and psychosocial factors on the onset of acute LBP at the emergency department of an emerging country.

## METHODS

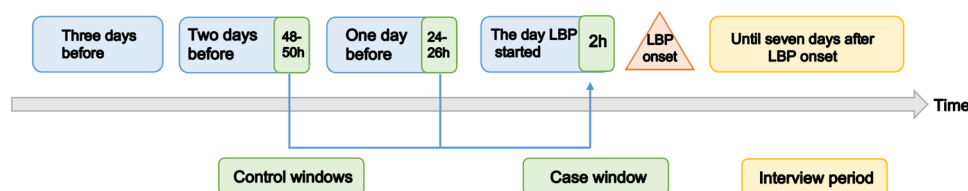
### Design

The study will be a case-crossover study. Ethics approval for the study was granted by the Universidade Cidade de São Paulo (#20310219.8.0000.0064).

In this case-crossover study, the time of the onset of LBP will be identified, and then data on exposure to a list of possible risk factors will be requested in the 72 hours preceding the onset of LBP. The exposure to each trigger during the 2 hours preceding the onset of LBP (case window) will be compared with exposure in the 2-hour periods ending 24 (24–26 hours) and 48 (48–50 hours) before the onset of LBP (control window). The following diagram (figure 1) explains the periods to be investigated and the case and control windows.

### Setting

We will recruit patients with recent onset non-specific acute LBP from emergency departments of public hospitals of São Paulo, Brazil. According to the National Register of Health Establishments, São Paulo has 52 centres specialised in emergency care in orthopaedics and traumatology.<sup>10</sup> We will invite three emergency departments of São Paulo’s distant regions to participate in the study. At the moment, one public hospital is currently actively involved in the recruitment stage. São Paulo can be considered a representative city of the Brazilian population because migration played an important role in the capital, which attracts the population from several Brazilian states to São Paulo. This area centralises most of the country’s activities, being characterised as a ‘global’ or ‘worldwide’ city with 12 million citizens.<sup>11–13</sup> Clinicians from emergency departments will invite potentially eligible patients with LBP to participate in this study.



**Figure 1** Diagram explaining the design method. The diagram indicates the key study features and its timing characteristics. The case and control windows are represented in green colour. The yellow square represents the interview period at the emergency department. The blue squares represent the investigation periods. LBP, low back pain.

## Patient and public involvement

There was neither patient nor public involvement in this research protocol.

## Participants

We will include patients aged between 18 and 80 years, presenting to an emergency department, with recent onset of acute non-specific LBP (pain between the gluteal folds and lower costal margins, lasting up to 7 days, with at least one previous pain-free month).<sup>14</sup> We will exclude patients with at least two signs that indicate nerve root compromise (weakness, changes in the reflex or loss of sensation); previous spinal surgery; cognitive impairment and patients with serious spinal pathologies such as fracture, tumour and inflammatory and infectious diseases.<sup>15</sup>

## Procedures

Patients will be informed about the study and invited to participate. The researchers will assess potential participants' eligibility and ask them to sign a consent form. The interview techniques were pilot tested. All researchers involved in the recruitment of the study underwent research training and applied the interview questionnaires to real patients in order to train the research procedures. A trained physiotherapist with experience in clinical research will conduct face-to-face interviews with participants. Sociodemographic data, clinical characteristics and data on exposure to possible triggers will be collected. The participants will be asked to identify the date and time of pain onset and report possible exposure, including time and duration, to a list of 11 possible triggers in the 72 hours preceding the onset of LBP. Table 1 describes the physical and psychosocial factors to be investigated as potential triggers.

In addition to these factors, we will ask participants to nominate the factor(s) they believe have triggered their LBP. For each factor listed above, the participants will respond if they were exposed or not on the day of, the day before, 2 days before and 3 days before the pain started. Also, we will ask for the duration of their exposure to triggering factors for sensitivity analysis. To minimise recall bias, participants will be encouraged to use their diary, calendar and/or smartphone to recall what they were doing in the assessment period. Additionally, questions about an event occurring in the period of interest will be ascertained and reinforced—for example, 'The day before your pain started, when you visited your mother, were you exposed to any of these factors?' To properly describe the participants characteristics, the information presented in table 2 will also be investigated. We will use a script to lead the interview following the model developed by Steffens *et al*,<sup>16</sup> which can be found in the online supplemental file.

## Blinding

For blinding purposes, participants will be blinded to the case and control windows. The study questionnaire is designed to investigate exposure to triggers over a longer

**Table 1** List of physical and psychosocial triggering factors to be investigated

Physical factors	Definition
Manual tasks involving heavy loads	Manual tasks include lifting, lowering, pushing, carrying or otherwise moving, holding or restraining any person, animal or item.
Manual tasks involving an awkward posture	For example, lifted 50 large boxes from the floor and placed them on a bench at waist height; knelt down while gardening;
Manual tasks with objects positioned away from the body	lifted a 4 m extension ladder from the car roof racks, carried to garage and hung on wall.
Manual tasks involving live people or animals	
Manual tasks involving a load that was unstable, unbalanced or difficult to hold or grasp	
Vigorous physical activity	This could be sports or hobbies, paid or volunteer work, work outside the home and housework perceived as vigorous intensity activity. For example, running, rope skipping, using heavy tools, axe chopping.
Moderate physical activity	This could be sports or hobbies, paid or volunteer work, work outside the home and housework perceived as moderate intensity activity. For example, leisure cycling, fishing, general home repairs, golf, general household work.
Tripping, slipping or falling	For example, descending stairs, missed bottom step and jarred back.
Sexual activity	For example, one time at 11pm.
Psychosocial factors	Definition
Distraction while engaged in a task or activity	For example, distracted by child crying while lifting a box from car boot and it slipped from his hands.
Fatigue or tiredness	For example, disrupted and poor sleep the night before as youngest child kept waking due to earache.
Alcohol consumption	For example, two glasses of red wine

time period than will be used in the analysis. For example, participants will be asked about their exposure to possible risk factors in the 3 days preceding their LBP onset and in the day the pain started. On the other hand, we will conduct analysis using the 2-hour period prior to the onset of LBP (case window) and 24–26-hour and 48–50-hour prior to the case window (referred to as the control windows). This method allows the participant to be blinded to the duration of the case and control windows.



**Table 2** List of variables to be collected and its measurement instruments

Variables	Instrument for assessment
Demographic, clinical and anthropometric data	<p>A standardised questionnaire containing information on:</p> <ul style="list-style-type: none"> <li>► Age; gender; weight; height; marital status; address; educational level; employment status; profession.</li> <li>► Number of LBP episodes; previous treatments for LBP; back pain medication usage.</li> <li>► Smoking status; presence of comorbidities; levels of anxiety and stress.</li> </ul>
Pain intensity	The NPRS evaluates pain intensity in the last week using a scale from 0 to 10, in which values closer to 10 indicate higher pain intensity. Questions 7 and 8 of the Short Form Health Survey (SF-36) will also be asked about the intensity and limitation of pain. <sup>21</sup>
Disability	The RMDQ assesses the degree of disability regarding to the LBP through 24 dichotomised questions. Higher scores indicate higher disability. <sup>22</sup>
Physical activity	Adapted version of Active Australia questionnaire to measure the level of physical activity practised in the last 2 weeks, as per previous study. <sup>2 23</sup>

LBP, low back pain; NPRS, Numerical Pain Rating Scale; RMDQ, Roland Morris Disability Questionnaire.

### Sample size calculation

We calculated the sample size required for a case-crossover study using previously described procedures.<sup>17 18</sup> In order to establish values for the sample size calculation, we used the results of the previous study<sup>2</sup> as a starting point. In that study,<sup>2</sup> most analyses resulted in ORs greater than 3.0, which we used as a minimum cut-off point for the sample size calculation of the present study. Therefore, with an alpha of 0.05, a sample of 350 cases will provide 80% probability to detect an OR of at least 3.0 for each trigger assessed.

### Data analysis

We will build conditional logistic regression models to quantify the risk of developing a new episode of LBP, associated with each investigated factor, where each participant represents both the exposure and the control. We will obtain ORs and 95% CIs by comparing risk factor exposure in the control and case periods. In addition, we will conduct secondary analyses to evaluate the association between the event exposure and the investigated factors of age, BMI, sex and duration of symptoms. The significance level adopted will be  $p < 0.05$ . We will perform all analyses using IBM SPSS software V.20.0 (IBM, Somers, New York, USA).

## DISCUSSION

This protocol provides a detailed description of a study for the replication of a previous case-crossover study<sup>2</sup> that investigated physical and psychosocial triggers for an acute episode of non-specific LBP. This replication study will recruit participants from a different setting (from emergency departments, in an emerging country), and the findings of the study could confirm and provide better information about brief exposure to a range of modifiable physical and psychosocial factors for developing a new episode of LBP.

Our study will recruit a large sample of patients with recent onset of non-specific LBP. In addition, the case-crossover design addresses some of the important limitations of previous studies investigating the risk factors of LBP.<sup>3</sup> To minimise the potential for recall bias, the maximum time between episode onset and the interview will be 7 days; we will be encouraging participants to use their smartphones and diaries to remember the investigated period. Also, our interview script asked participants to nominate key aspects of each day (eg, 'That was the day...' (the interviewer would restate the participant's description of the day—ie, 'That was the quiet, warm day you went to church')). Furthermore, participants will be blinded to the case and control periods. Despite the efforts, the study presents some inherent recall bias of a retrospective study. Other case-crossover studies used this strategy with success, suggesting that patients are able to recall data on the preceding days of the event.<sup>2 19</sup> In addition, the script to lead the interview on exposure to triggering factors was not tested for its measurement properties. A previous study conducted in Australia used the proposed questionnaire.<sup>2</sup> The questionnaire is based on simple questions that depend on the participant's life experience of having or not being exposed to a list of risk factors, and it can be found in the online supplemental file.

The findings of this study, tested in a different context, will provide research evidence with clinical and policy implications. Future research may use this study's findings to develop and evaluate prevention programmes that aim to reduce exposure to these triggers by avoiding or reducing such factors through education. Exposure to triggers, such as manual tasks involving weightlifting, can be avoided in work environments by adapting the work setting and practices. Triggers can also be reduced through educational practices to the general population as well. Risk factors such as tripping and falling can be addressed through fall-prevention programmes. Fall-prevention strategy programmes aimed at the elderly population are often successful.<sup>20</sup> Changing human behaviour is not simple; however, the burden and negative impact of LBP show us that something must be done. Therefore, clinicians will be better informed about robust estimates for the increased risk of LBP following exposure to modifiable physical and psychosocial triggers. In the future, new policy initiatives regarding prevention

based on exposure to modifiable physical and psychosocial triggers may be created for the control of LBP.

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