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Pain One Week After an Emergency Department Visit for Acute Low Back Pain Is Associated With Poor Three-month Outcomes

Benjamin W. Friedman, MD, MS, John Conway, Caron Campbell, MD, Polly E. Bijur, PhD, and E. John Gallagher, MD

ABSTRACT

Background: Low back pain (LBP) is responsible for more than 2.5 million visits to U.S. emergency departments (EDs) annually. Nearly 30% of patients who present to an ED with acute LBP report functional impairment or pain 3 months later. These patients are at risk of chronic LBP, a highly debilitating condition. In this study, we assessed whether three variables assessable shortly after symptom onset could independently predict poor 3-month outcomes among LBP patients who present to an ED.

Methods: This was a planned analysis of data from two randomized comparative effectiveness studies of patients with acute, nontraumatic, nonradicular LBP. Patients were enrolled during an ED visit, contacted by telephone 1 week after the ED visit, and then followed up by telephone 3 months later. The coprimary 3-month outcomes were LBP-related functional impairment and persistent moderate or severe LBP. Two of the three hypothesized predictor variables were assessed during the index visit: 1) the STarT Back Screening Tool score, a nine-item, multidimensional tool validated and widely used in the outpatient setting, and 2) the patient’s own anticipated duration of LBP. The third hypothesized predictor was presence of pain assessed by phone 1 week after the ED visit. We then determined whether these three predictor variables were independently associated with poor outcomes at 3 months, after controlling for medication received, age, and sex.

Results: A total of 354 patients were enrolled. Of these, 309 (87%) provided 3-month impairment data and 311 (88%) provided 3-month pain data. At 3 months, 122 of 309 (39%) patients reported functional impairment and 51 of 311 (16%) patients reported moderate or severe LBP. Among the three hypothesized predictor variables, 58 of 352 (16%) patients with available data reported a moderate or high STarT Back Screening Tool score, 35 of 321 (11%) patients with available data reported anticipated duration of LBP > 1 week, and 235 of 346 (68%) patients reported pain at 1-week telephone follow-up. After age, sex, and medication received were controlled for in a multivariable logistic regression model, only pain at 1 week was independently associated with 3-month impairment (odds ratio [OR] = 2.42, 95% CI = 1.39–4.22) and 3-month moderate or severe pain (OR = 3.83, 95% CI = 1.53–9.58).

Conclusions: More than one-third of patients reported functional impairment 3 months after an ED visit for acute, nontraumatic, nonradicular LBP. Moderate or severe LBP was less common, reported in about half as
many patients (16%). Of the three hypothesized predictor variables, only persistent pain at 1 week was independently associated with poor outcomes at 3 months. Despite its important role in the outpatient setting, the STarT Back Tool was not associated with poor outcomes in this ED cohort.

Low back pain (LBP) causes more than 2.5 million visits to U.S. emergency departments (EDs) annually. Among the subset of ED patients who present with acute LBP, most will recover, although 10% to 20% of this group report moderate or severe LBP 3 months later and 30% report LBP-related functional impairment. These patients are at risk for chronic LBP, a debilitating, highly prevalent condition that erodes quality of life and accounts for more than $600 billion in direct and indirect costs annually. Identifying those ED patients at risk for progression from acute, new-onset LBP to chronic back pain will allow integrated health care systems to target these patients with more resources, with the long-term goal of preventing this progression from acute to chronic LBP.

In this planned analysis of data collected during two randomized comparative effectiveness studies, we assessed whether clinical features available either during the index ED visit or shortly thereafter could predict poor functional or pain outcomes 3 months later. We assessed three variables that were both easy to measure and have been associated with long-term LBP outcomes:

1. The STarT Back Tool, a nine-item, multidimensional low back prediction instrument that has been validated and is widely used in the outpatient setting;
2. The patient’s own prediction, in days, of anticipated LBP duration;
3. The presence or absence of LBP 1 week after the ED visit, as assessed during a follow-up phone call.

We hypothesized that these three items would be independently associated predictors of LBP and related functional impairment at 3 months.

**METHODS**

**Overview**

This was a planned analysis of data gathered from two ED-based randomized comparative effectiveness trials of patients with new-onset, nontraumatic, nonradicular musculoskeletal LBP. In one study, patients were randomized to treatment with 7 days of naproxen + placebo, naproxen + orphenadrine, or naproxen + methocarbamol (March 2016–February 2017). The study protocols were identical, with the exception of slightly different exclusion criteria, which were necessary because of slightly different contraindications to investigational medications. In both studies, research personnel provided each patient with a 10-minute educational intervention. This was based on the National Institute for Arthritis and Musculoskeletal disease’s Handout on Health: Back Pain information webpage (available at http://www.niams.nih.gov/Health_Info/Back_Pain/default.asp). In both studies, a structured follow-up interview was conducted by telephone 1 week and 3 months after the ED visit. No significant difference in functional outcome or presence of LBP was found among the various treatment groups in either study at 3 months. All patients provided written informed consent. These studies were reviewed and approved by the Albert Einstein College of Medicine Institutional Review Board.

**Setting**

These studies were conducted in two affiliated EDs of Montefiore Health, an urban teaching medical center in Bronx, NY, with a total of 178,000 adult visits annually. Salaried, trained, fluently bilingual (English and Spanish) research associates staffed the EDs 18 to 24 hours per day, 7 days per week during the study periods.

**Subject Selection**

Patients were considered for inclusion if they were aged 18 to 69 years and presented to the ED primarily for management of acute LBP, defined as pain of 2 weeks duration or less originating between the lower border of the scapulae and the upper gluteal folds, and received a diagnosis consistent with musculoskeletal LBP, as determined by the attending emergency physician. Patients were required to have functionally impairing back pain. Patients were excluded for radicular pain, which we defined as pain radiating below the gluteal folds in a dermatomal pattern (a known high-risk feature of poor outcomes), direct trauma to the back within the previous month, or recent history of more than one
LBP episode per month. We also excluded patients who were pregnant or lactating, unavailable for follow-up, reported an allergy or contraindication to the investigational medications, had a chronic pain syndrome, or had chronic opioid use currently or in the past. Chronic pain was defined as pain requiring analgesics on more days than not prior to onset of the acute LBP. Chronic opioid use was defined as daily or near-daily use of opioids during the previous month.

**Measures**

**Hypothesized Predictors Assessed During the Index ED Visit. STarT Back Tool.** This is a nine-item low back prediction instrument that includes questions about upper spine and leg pain, low back–related functional impairment, depression, and catastrophizing at some time during the preceding 2 weeks (https://www.keele.ac.uk/sbst/startbacktool/). In the outpatient setting, it is associated with long-term functional and pain outcomes, can be used to provide care efficiently to LBP patients, and reduces LBP-related healthcare costs by directing care toward those patients who most need it.\(^6\)

**Anticipated Duration.** Prior to discharge during the baseline ED visit, participants were asked, “Sometimes it’s difficult to predict, but what is your best guess for how long this episode of back pain will last?” Answers were recorded in number of days and dichotomized into < 1 week versus > 1 week. This measure forces the patient to integrate a variety of components into one summary measure—current pain and functional impairment relative to prior occurrences of pain and functional impairment as well as overall health, psychosocial stressors, general attitudes, and coping mechanisms such as catastrophization (defined as an overwhelming and irrational negative attitude about a disease process), which has been associated with long-term low back functional disability and pain.\(^7\)

Data on anticipated duration of LBP and the STarT Back Tool variables were collected at the index visit during structured, in-person interviews of the patient by research associates.

**Hypothesized Predictor Assessed 1 Week After the Baseline Visit.** Pain was assessed using a four-point ordinal scale. During a structured telephone interview 1 week after the index visit, patients described their LBP as “severe,” “moderate,” “mild,” or “none.” The 1-week pain level, dichotomized into “some pain” or “no pain,” was used to predict 3-month outcomes. One-week pain scores have been associated with poor long-term LBP outcomes in previous work.\(^8\)

**Outcomes**

Important outcomes in LBP research include both the pain itself and the LBP-related disability. We therefore chose two coprimary outcomes to be assessed 3 months following the index ED visit: 1) LBP-related functional impairment and 2) the presence of moderate or severe LBP.

Functional impairment was measured with the 24-item Roland-Morris Disability Questionnaire (RMDQ), a valid and reproducible instrument used extensively in LBP research.\(^10\) It includes 24 questions that assess the extent to which LBP impairs an individual’s ability to perform activities of daily living, such as putting on socks, climbing stairs, and interacting with others. A score of 0 indicates no back pain–related functional impairment, while a score of 24 indicates severe functional impairment related to back pain. The RMDQ was administered by telephone 3 months after the ED visit. To improve clinical relevance, patient RMDQ scores were dichotomized into a score of 0, indicating no functional impairment, or greater than 0, indicating the presence of back pain–related functional impairment. There is no other point in the RMDQ at which dichotomization carries comparable clinical significance. We considered the presence of any LBP-related functional impairment at 3 months to be a clinically important adverse outcome in this previously healthy population.

The second primary outcome was the presence of LBP at 3 months. This outcome, like the RMDQ, was also dichotomized. Here, pain was dichotomized into groups of none or mild pain versus moderate or severe pain, as this simple cut point is used commonly in ED-based LBP research.\(^3,8,10\) Our two coprimary outcomes can be considered complementary: RMDQ > 0 is a more sensitive outcome in that is more likely to detect anyone with clinically important LBP. Pain greater than mild is more specific in that it is less likely to include patients without clinically important LBP.
Data Analysis
Baseline characteristics of the cohort, including age, sex, index RMDQ score, and investigational medication regimen received are reported as mean with standard deviation (SD), median with interquartile range, or frequency with percent, as appropriate. Data for each of the three hypothesized predictors are reported as frequency with percent. Similarly, 3-month outcomes are reported as frequency with percent.

The bivariate associations between hypothesized predictors and 3-month outcomes are reported as unadjusted odds ratios (ORs) with 95% confidence interval (CI). To enable computation of ORs, each of the hypothesized predictors was dichotomized at clinically sensible cut points: for the STarT Back Tool, this was low risk versus moderate + high risk; for anticipated duration of LBP, this was at 7 days; and for LBP at 1 week, this was presence of pain versus absence of pain.

Multivariable logistic models were constructed to identify and quantify the independent associations between the three hypothesized predictors and the two primary outcome variables: 3-month RMDQ score and moderate or severe LBP. In addition to the three hypothesized predictors, age, sex, and study medication were included in the regression model. The results of the multivariable logistic regression models are presented as ORs with 95% CIs. Patients with missing predictor or outcome data were excluded from the multivariable models. We calculated sensitivity and specificity (with 95% CI) and positive and negative predictive values (with 95% CI) for all variables associated with the primary outcomes.

RESULTS
Altogether, 354 patients were enrolled (Figure 1). Of these, 309 (87%) provided 3-month functional data (RMDQ) and 311 (88%) provided 3-month pain data. Characteristics of the cohort at baseline are presented in Table 1. Severe functional impairment during the index visit, as measured by the RMDQ was common. STarT Back Screening Tool risk was generally low. The majority (89%) of patients thought their pain would last less than 1 week (Table 1 and Data Supplement S1, available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13453/full). By 1 week after the ED visit, 111 of 354 (31%) patients with available data reported no pain (Table 1). By 3 months after the initial ED visit, 122 of 309 (39%) patients reported LBP-related functional impairment (RMDQ > 0) and 51 of 311 (16%) patients reported moderate or severe LBP.

Baseline STarT Back score was not associated with either functional impairment (OR = 0.75, 95% CI = 0.4–1.42) or pain at 3 months (OR = 0.39, 95% CI = 0.14–1.15; Tables 2 and 3). Anticipated pain duration was associated with both outcomes in bivariate analyses (Table 2) but was not associated with either functional impairment (OR = 1.47, 95% CI = 0.78–2.75) or pain (OR = 1.49, 95% CI = 0.71, 3.12) in multivariable modeling (Table 3). Pain at 1 week was associated with both outcomes (Table 3), although positive predictive values were less than 50% for functional impairment and less than 25% for moderate or severe pain (Table 4).

DISCUSSION
Approximately one-third of patients who visit the ED for acute, nontraumatic, nonradicular LBP will report pain or functional impairment 3 months later. These patients are at risk of chronic LBP, a debilitating, costly, and difficult-to-treat condition. To date, few published data are available to determine which individual ED LBP patients are at risk of poor long-term outcomes. In this study, we validated persistence of pain 1 week after the initial visit as a moderate predictor of poor 3-month pain and functional outcomes, although because of modest test characteristics, this may not be useful clinically when dealing with individual patients. Interestingly, the STarT Back Tool, which is used in the outpatient setting to allocate resources to LBP patients, was not associated with either of the 3-month outcomes in this study and therefore is not appropriate for use among acute LBP patients in an ED. Unfortunately, these data are most useful for demonstrating to emergency clinicians what not to rely upon for predicting LBP outcomes.

In the outpatient setting, outcomes after acute, nonradicular LBP are associated with a variety of variables including psychological factors such as catastrophization and depression, social factors including work status, and medical features such as severity of the underlying pathology. It is clear that the transition from acute to chronic pain involves more than just biological variables. However, contextualizing biopsychosocial variables into clinically effective predictors for individual ED LBP patients has been
difficult.\textsuperscript{5,10} Because currently available clinical tools are not effective predictors of outcomes among ED patients, we hoped that the patient’s stated anticipated duration would allow each individual patient to incorporate the various components listed above into one clinically meaningful summary value because it would allow the patient to integrate an assessment of current pain and functional impairment relative to prior occurrences of pain and functional impairment along with overall health, psychosocial stressors, general attitudes, and coping mechanisms such as catastrophization. Indeed, in this analysis, anticipated duration of pain was associated with 3-month outcomes in bivariate analyses and some of the multivariable analyses, although it did not play a meaningful role in our primary multivariable models. Still, for emergency clinicians, who will not have access to 1-week data during the initial ED visit, asking patients about expected duration of pain is the best available predictor of poor outcomes.

One-week pain was the hypothesized predictor independently associated with both functional impairment (adjusted OR = 2.4) and pain (adjusted OR = 3.8) at 3 months, an association that we have identified in previous work as well.\textsuperscript{8} Unfortunately, the test characteristics are modest at best: the negative predictive value with regard to moderate or severe pain at 3 months was 94\% but the negative predictive value with regard to functional impairment was only 75\%, and the positive predictive values were < 50\%. These values seem insufficient to enable our ultimate goal: the efficient allocation of LBP resources.

Surprisingly, the STarT Back Tool, which has been validated in the primary care setting and whose application has been shown to improve functional disability outcomes through efficient allocation of resources,\textsuperscript{6} did not predict outcomes in this cohort. The lack of predictive ability could be explained by important differences between the patient population found in our studies and the population in which STarT Back was

\textbf{Figure 1.} Flow diagram. *Four patients were excluded for more than one reason. LBP = low back pain; RMDQ = Roland-Morris Disability Questionnaire.
The patient population on which STarT Back was derived was older, had lower baseline functional impairment, often had radicular back pain, had a much longer duration of back pain, and had generally worse outcomes than patients enrolled in the two clinical trials analyzed here, which restricted enrollment to patients with acute, nonradicular LBP. Questions in this instrument about mood, catastrophizing, and pain at other remote body sites are probably less relevant to our cohort of previously healthy patients.

The idea that a multidimensional LBP instrument is less relevant to acute LBP in the ED is supported by two studies, one of acute pain and one that includes a more diverse mix of patients with LBP. In a previous ED-based study of patients with acute LBP, depression, psychosomatic symptomatology, and measures of baseline impairment failed to predict poor 3-month outcomes. The former two were uncommon among those with acute LBP and the latter was so common that it failed to discriminate between those destined to have good or poor outcomes. Among a general ED cohort of LBP patients that included acute, subacute, and chronic patients with or without radiculopathy, longer duration or more frequent symptoms and baseline functional impairment were associated with poor 3-month outcomes, albeit only modestly. Clearly, more work is needed to define a high-risk population of ED acute LBP patients requiring more intensive post-ED follow-up and management.

**LIMITATIONS**

A number of limitations must be mentioned. First, these studies were conducted in two urban EDs in the Bronx, NY. It is not clear whether these results can be generalized to a broader ED population. Second, our outcome assessments were a snapshot in time rather than a more comprehensive assessment of our

<table>
<thead>
<tr>
<th>Hypothesized Predictors</th>
<th>STarT Back Tool</th>
<th>OR</th>
<th>95% CI</th>
<th>Sig.</th>
<th>Anticipated duration</th>
<th>3-month RMDQ &gt; 0</th>
<th>OR</th>
<th>95% CI</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low risk</td>
<td>1</td>
<td></td>
<td></td>
<td>&gt;7 days</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium/high risk</td>
<td>0.75</td>
<td>0.40–1.42</td>
<td>0.38</td>
<td>&gt;7 days</td>
<td>1.93</td>
<td>0.79–3.34</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1-week pain</td>
<td>2.66</td>
<td>1.57–4.50</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>None</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>

The relationship between anticipated duration and 3-month RMDQ score is depicted in the Data Supplement S1.

RMDQ = Roland Morris Disability Questionnaire.
patients’ ongoing pain and impairment. Patients who happened to have functional impairment or pain on the day that we called to determine 3-month status were considered a bad outcome, even if they did not have impairment or pain for many of the preceding 89 days. Third, assessing pain 1 week after the ED visit is less relevant to the emergency clinician caring for the patient during an index visit. However, 1-week predictors can be used by the health care system to deliver appropriate levels of care to LBP patients. Fourth, this study was an analysis of data gathered from two previous ED studies, rather than one specifically designed to answer the current study question primarily. Fifth, we did not examine a comprehensive set of biopsychosocial predictions (e.g., depression or psychosomatization), because they have previously been shown not to be predictive of poor LBP outcomes in an ED population. Sixth, we excluded older adults, even though this is an important subgroup of patients at high risk for persistent pain and also at risk for medical complications. We did so because of increased risk from the investigational medications. Seventh, asking patients about pain severity at 1 week is less easy than asking patients questions in the ED. Finaly, the 3-month pain

<table>
<thead>
<tr>
<th>Hypothesized Predictors</th>
<th>3-month RMDQ &gt; 0</th>
<th>3-month Pain Moderate/Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>STarT Back risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium/high</td>
<td>0.87 (0.44–1.71)</td>
<td>0.69 (0.42–1.26)</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Anticipated duration (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;7</td>
<td>1.47 (0.78–2.75)</td>
<td>0.23 (1.49–7.12)</td>
</tr>
<tr>
<td>≤7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1-week pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some</td>
<td>2.42 (1.39–4.22)</td>
<td>&lt;0.01 (3.83–9.58)</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
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Adjusted for age, sex, and medication received. All three predictor variables + age, sex, and medication were entered into one multivariable logistic model. For models containing individual predictors + age, sex, and medication, and other permutations on these models, please see Data Supplement S1. A total of 308 patients had complete data and were included in the functional outcome analysis, while 309 patients had complete data for the pain analysis.

Two of the predictor variables, anticipated duration and 1-week pain are correlated (Spearman’s rho = 0.17, p = 0.001). Because collinearity may have impacted this model, we reran the models, first without anticipated duration and then without 1-week pain. After 1 week pain was removed from the RMDQ > 0 model, the OR of anticipated duration increased to 1.74 (95% CI = 0.95–3.20). After anticipated duration was removed from the RMDQ > 0 model, the OR of 1-week pain increased to 2.56 (95% CI = 1.48–4.44). After 1-week pain was removed from the moderate/severe pain model, the OR of anticipated duration increased to 1.89 (95% CI = 0.93–3.84). After anticipated duration was removed from the moderate/severe pain model, the OR of 1-week pain increased to 4.12 (95% CI = 1.67–10.19). We concluded that collinearity did not impact these models meaningfully.

RMDQ = Roland Morris Disability Questionnaire.

<table>
<thead>
<tr>
<th>Predictor value</th>
<th>Disease ++: RMDQ &gt; 0</th>
<th>Disease +=: RMDQ = 0</th>
<th>Disease +: Moderate/Severe pain</th>
<th>Disease -: Mild/No Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test ++: pain at 1 week</td>
<td>97</td>
<td>111</td>
<td>45</td>
<td>164</td>
</tr>
<tr>
<td>Test +: no pain at 1 week</td>
<td>25</td>
<td>76</td>
<td>6</td>
<td>95</td>
</tr>
</tbody>
</table>

Functional outcome

Sensitivity: 0.80 (95% CI = 0.71–0.86)
Specificity: 0.41 (95% CI = 0.34–0.48)
Positive predictive value: 0.47 (95% CI = 0.40–0.53)
Negative predictive value: 0.75 (95% CI = 0.66–0.83)

Pain outcome

Sensitivity: 0.88 (95% CI = 0.76–0.95)
Specificity: 0.37 (95% CI = 0.31–0.43)
Positive predictive value: 0.22 (95% CI = 0.16–0.28)
Negative predictive value: 0.94 (95% CI = 0.87–0.98)

RMDQ = Roland Morris Disability Questionnaire.
outcomes in our study were generally satisfactory, which while good for our patients, limited the power of this analysis.

CONCLUSION

In conclusion, more than one-third of patients reported functional impairment 3 months after an ED visit for acute, nontraumatic, nonradicular low back pain and one in six reported moderate or severe low back pain. Persistent pain at 1 week was the only hypothesized predictor variable associated with poor outcomes at 3 months, although this association was not robust. Despite demonstrated utility in the non-ED setting, the STarT Back Tool was not associated with poor outcomes in this cohort.

References


Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13453/full

Data Supplement S1. Appendix.