Patient predictor variables for six forms of suicidality

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Abstract

Objectives: There has been a significant amount of research performed on the relationship between the presence of chronic pain and all forms of suicidality. This study explored which rehabilitation acute pain patient (APP) and rehabilitation chronic pain patient (CPP) variables are predictive of six suicidality items: wanting to die because of pain; wanting to die because life is hard; history of wanting to die; history of suicide attempts; recent frequent suicide ideation; and having a suicidal plan.

Methods: The six suicide items were contained within the Battery for Health Improvement-Research Version (BHI-R) and were administered to a healthy community sample \((n = 1478)\), community patients \((n = 158)\), rehabilitation APPs \((n = 326)\), rehabilitation CPPs \((n = 341)\) and rehabilitation patients without pain \((n = 110)\).

Results: Affirmation of the six items in APPs/CPPs ranged from 6.13% to 34.90%. Logistic regression predictor models for each item for APPs/CPPs were developed utilizing available variables from the BHI-R. Predictor variables differed between APPs and CPPs and between items. Most predictor variables had previously been delineated in non-pain behaviour studies (e.g., substance abuse). Some novel variables such as perseverance were also identified. Contrary to the behaviour suicide literature, no demographic variables (except employment) were predictive. Correct patient classification ranged from 87% to 95%, in most cases being better than the base rate prediction.

Discussion: Suicidality predictor variables were differentially distributed between APPs and CPPs and between different forms of suicidality. Some suicidality predictor variables appeared to be specific to pain patients.

1. Introduction

Beginning with a study by Fishbain and colleagues (Fishbain et al., 1991), a number of studies have explored the relationship between chronic pain and suicidality. Reviewers (Fishbain et al., 1995; Tang and Crane, 2006) concluded that chronic pain patients (CPPs) are at greater risk than the general population for all forms of suicidality. Based on this research, the presence of pain has been added to the list of ‘suicide risk factors’ (American Psychiatric Association, 2003). However, no consistent list of CPP variables predictive of suicidality has been developed. Depression pain-related catastrophizing (Edwards et al., 2006), hopelessness (Campbell et al., 2003), headache (Morriss et al., 1999; Evans et al., 2005), head pain (Chellappa and Ramaraj, 2009), non-back or neck pain, chronic pain (Morriss et al., 1999; Fava et al., 2006), history of
suicide attempt (Fisher et al., 2001) and pain scores (Chellappa and Ramaraj, 2009) have been shown to be associated with increased risk for suicidal ideation. However, in one study, pain severity and depression were not associated with suicidal ideation (Smith et al., 2004a). Passive suicidal ideation was associated with family suicidality (Smith et al., 2004a), insomnia (Smith et al., 2004b), abdominal pain (Smith et al., 2004a) and pain (Smith et al., 2004b, 2004a). Suicidal ideation was associated with a family history of suicide attempts/completions (Smith et al., 2004a). Suicide attempts were associated with depression (Evans et al., 2005), pain (Evans et al., 2005; Fava et al., 2006; Chellappa and Ramaraj, 2009) and pain score (Chellappa and Ramaraj, 2009). Suicide completion has been shown to be associated with depression (Swedlow, 2010) and pain (Marcus et al., 2009).

The literature indicates that suicidality predictor variables may be differentially distributed among pain types and forms of suicidality. We recently investigated (Fishbain et al., 2009b) the risk for affirmation for five suicidality items (history of wanting to die, wants to die because of pain, recent suicide ideation, has a suicide plan, history of suicide attempt) comparing APPs, CPPs, patients without pain, community patients and community healthy subjects. APPs were found to be at greater risk for all five forms of suicidality versus community healthy. CPPs were at greater risk for three of the five suicidality items. Risk was increased by such variables as worker compensation, litigation, and personal injury, indicating that some of these variables could be predictive of some forms of suicidality. The study described below is a follow-up to the above study. Here, we try to develop variable predictor models for each of these five suicidality items plus an additional item (wanting to die because life is hard) for APPs and CPPs.

2. Methods

2.1 Subjects/participants

This is a data mining study on a data set of 600 items termed the Battery for Health Improvement-Research (BHI-R) (Bruns and Disorbio, 2003). The BHI-R is not an inventory or test. These items were compiled to develop the Battery for Health Improvement 2 (BHI-2) whose items are made up of a subset of the BHI-R items. The subject of the present study is six BHI-R items that appear to have face validity for suicidality. The 600 BHI-R items were administered to 777 patients undergoing rehabilitation treatment for pain or a physical injury in 30 states in all geographical regions of the continental United States. They were recruited by posters or flyers provided to them by their providers and were from a variety of settings: physical therapy, work hardening programs, chronic pain programs, physician offices and vocational rehabilitation settings. These patients were also drawn from various payor systems (Medicare/Medicaid, private insurance, worker’s compensation and personal injury insurance). Their non-specific and specific diagnoses are presented in Supporting Information Table S1 as a percentage of the total rehabilitation patient group (n = 777) (some patients had more than one diagnosis). These diagnoses were received from the treating facilities either before referral to the facility or during treatment. We have no information as to what types of physicians assigned these diagnoses. Of these 777 rehabilitation patients, 667 had pain [Numerical Rating Scale (NRS) score greater than zero] and 110 had no pain. Of patients with pain, 341 suffered from chronic pain (CPPs; greater than 90 days duration). The remaining patients (n = 326) had acute pain (APPs; less than 90 days duration).

Community healthy (n = 1329; reported no serious medical condition) and community patients (n = 158; reported a serious medical condition) groups were also administered the 600 BHI-R items. These subjects were from 16 states in all geographical areas of the continental United States. They were recruited by newspaper advertisements and posters; stratified according to race, education, age and gender; and recruited to match these demographics. No subject was excluded on the basis of past or present medical or psychological diagnoses.

2.2 Instrumentation

Two of the BHI-R items related to a horizontal 10 cm NRS score anchored at 0 (no pain or discomfort) and 10 (worst pain or discomfort I can imagine having). Using this scale, and considering all of the pain-affected parts of the body, the subjects were asked to rate both the highest and the lowest pain experienced in the last month. There was also a question as to how long this pain was present.

As the BHI-R is not an inventory, it contains no scales and, therefore, has no associated reliability and validity data. However, each item in the BHI-R has 1-week test–retest reliability scores. The six suicidality items under investigation had the following test–retest reliability range: 0.78–0.89. Some BHI-R items have been found to be associated with some interesting clinical issues (Fishbain et al., 2007, 2008, 2009a,b,
2010; Bruns and Disorbio, 2005, 2009; Bruns et al., 2010).

The BHI-2 was developed from the pool of BHI-R items and contains 18 scales (Bruns and Disorbio, 2003). Test–retest reliability of these scales ranged from 0.88 to 0.97 and the mean test–retest reliability was 0.93. Internal reliability of these scales ranged from 0.75 to 0.97, and the mean internal reliability of these scales was 0.84. The validity of these scales was tested against a number of instruments outlined in the manual (Bruns and Disorbio, 2003).

2.3 Data collection procedures

Participation was by self-selection; subjects were reimbursed for their participation. Any patient wishing to participate in the BHI-R study was allowed study entrance. The only exclusion criteria were being less than 18 years or over 65 and not being able to read the BHI-R items. The BHI-R items were administered in a confidential manner (questionnaires were assigned a random ID number). No records were kept regarding which ID number a patient or non-patient was assigned; the data were processed by persons having no contact with, or knowledge of, the respondents (data were de-identified). All groups signed an informed consent form developed by Pearson Assessments and reviewed by an internal committee that had followed institutional review board principles. The BHI-R data set was presented in a de-identified format for data analysis.

2.4 Data analysis

Response groups (affirmation vs. non-affirmation) to the six suicidality items were established as follows. Each item was scored on a Likert scale format with the responses being strongly disagree, disagree, agree and strongly agree (assigned scores 1 through 4, respectively). For the analyses described below, items were transformed into a dichotomy. Thus, participants were classified as agreeing with the item if they agreed or strongly agreed.

Data were analysed using SPSS 15.0 software (IBM, Armonk, NY, USA). Frequency and descriptive statistics were calculated to check all relevant characteristics of the data for each patient group. For each suicidality item, we attempted to develop variable predictor models for rehabilitation APPs and rehabilitation CPPs. We attempted to include community patients and rehabilitation patients without pain in this analysis. However, for these two groups, there were an insufficient number of subjects affirming the six suicidality items to perform the analyses, and the small overall sample size led to failure to develop predictor models for these groups.

For each form of suicidality, predictor variables for rehabilitation APPs and rehabilitation CPPs were identified as follows: First, the BHI-2 was scored from the responses of the different groups to the BHI-2 items contained within the BHI-R. Four of the six suicidality items (history of suicide ideation, history of suicide attempt, recent frequent suicide ideation, wanting to die because life is hard) under investigation were in the BHI-2 scales. As this would contaminate the results, these four items were removed from their associated BHI-2 scales; all the scales were then renormed, using the original norm groups, and new T-scores based on the modified scales were calculated. It was these modified T-scores that were used in this study. Only valid BHI-2 profiles were utilized in the analyses described below. Additional BHI-R variables used are listed in Supporting Information Table S2. Second, Student’s t-tests were used to assess the BHI-2 scales, age and pain scores for each pain group separately for each suicidality item. Chi-squares were used for categorical demographic and clinical history variables, comparing those who responded affirmatively on the suicidality items to those who did not. Third, correlation coefficients were calculated among all of the six suicidality items for APPs and CPPs. Fourth, for each significant (p ≤ 0.001) BHI-2 scale, we broke the scale down into each of its individual items. We then compared the APPs and CPPs, affirming each of the suicidality items to those not affirming the suicidality items by chi-square for each of the individual scale items, and isolated the significant items: those at p ≤ 0.001. We employed this stringent criterion level (p ≤ 0.001) to choose significant variables for further analysis because it served to reduce the risk of false positives (type 1 error) due to performing multiple statistical tests. This also ensured that variables would be significant regardless of the correction method chosen. Fifth, these significant (p < 0.001) variables were then used as independent variables in logistic regression models to assess the predictability of these variables on each of the six suicidality items in APPs and CPPs. There were very high significant correlations (majority at <0.001) between the six suicidality items themselves (Supporting Information Table S4), so each of these items was tested for its ability to predict the other five items. In addition, we added two additional items from the BHI-R data set to the analysis: patients wish to sue their physician and presence of patient violent ideation against physicians. These items were added because we have previously shown
that these two items can be significant clinical issues (Fishbain et al., 2007, 2008, 2009a) in APPs and CPPs. These items are hostility-violence associated and there is some evidence that suicide may be a violence wish turned inward. (Fishbain et al., 2000)

3. Results

3.1 Percentage agreement with suicide items

Supporting Information Table S3 displays the total number and percentage of each group (community health subjects, community patients, rehabilitation patients without pain, rehabilitation patients with acute pain, rehabilitation patients with chronic pain) who endorsed the six suicide items. In addition, it displays two scores and p-values for comparisons between some of these groups for affirmation of each suicidality item. It is to be noted that APPs and CPPs were significantly more likely than community healthy to have a greater frequency of endorsement for every suicidality item while this was not the case for the community patient group. APPs had a greater frequency of endorsement for two suicidality items versus community patients while CPPs had a greater frequency of endorsement for three out of the six. Finally, CPPs had a greater frequency of endorsement for three of the six items versus APPs.

3.2 Correlation matrices of six suicide items for APPs and CPPs (Supporting Information Table S4)

For both groups of patients, all items were significantly correlated among themselves. Correlation values ranged from 0.15 to 0.49 for APPs and from 0.19 to 0.45 for CPPs.

3.3 Final logistic regression model with significant independent variables for wanting to die because life is hard as the dependent variable for APPs and CPPs

For APPs, the final model (Table 1) identified six predictor variables: history of wanting to die, having a suicide plan; and items from the family dysfunction, hostility and anxiety scales of the BHI-2. The final model chi-square was significant ($\chi^2 = 129.9[6], p < 0.001$), explained 53% of the variance in the dependent variable and classified 89% of the subjects correctly.

For CPPs, the final model (Table 1) identified six variables: history of wanting to die; wanting to die because of pain; history of wanting to die after setbacks; things are bad in my house now; I am mean to people I care about; wanting to die because of pain.
because of pain; the BHI-2 depression scale; and items from the BHI-2 scales of perseverance, family dysfunction and borderline. The final model chi-square was significant ($\chi^2 = 187.6[6], p < 0.001$), explained 63% of the variance in the dependent variable and classified 89% of the subjects correctly.

### 3.4 Final logistic regression model with significant independent variables for wanting to die because of pain as the dependent variable for APPs and CPPs

The final model (Table 2) identified four predictor variables for APPs: BHI-2 somatic complaints scale and items from the BHI-2 depression, somatic complaints and muscular bracing scales. The final model chi-square was significant ($\chi^2 = 56.7[4], p < 0.001$), explained 43% of the variance in the dependent variable and classified 95% of the subjects correctly.

For CPPs, the final model (Table 2) identified five predictor variables: the BHI-2 substance abuse scale and items from the BHI-2 scales of depression, muscular bracing and functional complaints. The final model chi-square was significant ($\chi^2 = 118.8[5], p < 0.001$), explained 53% of the variance in the dependent variable and classified 89% of the subjects correctly.

### 3.5 Final logistic regression model with significant independent variables for history of wanting to die as the dependent variable for APPs and CPPs

The final model (Table 3) identified seven predictor variables for APPs: the BHI-2 depression and symptom dependency scales and items from the borderline, depression, somatic complaints, family dysfunction and hostility scales of the BHI-2. The final model chi-square was significant ($\chi^2 = 183.3[7], p < 0.001$), explained 64% of the variance in the dependent variable and classified 89% of the subjects correctly.

The final model (Table 3) identified five predictor variables for CPPs: items from the BHI-2 depression, borderline and perseverance scales. The final model chi-square was significant ($\chi^2 = 172.4[5], p < 0.001$), explained 55% of the variance in the dependent variable and classified 83% of the subjects correctly.

### 3.6 Final logistic regression models with significant independent variables with history of suicide attempt as the dependent variable for APPs and CPPs

The final model (Table 4) identified five predictor variables for APPs: the BHI-2 hostility, borderline and...
### Table 3  
Final model logistic regression results for significant independent variables with history of wanting to die as the dependent variable for acute and chronic pain patients.

<table>
<thead>
<tr>
<th>Step&lt;sup&gt;e&lt;/sup&gt; (df), p-value</th>
<th>% of cases predicted correctly by the model</th>
<th>Step Nagelkerke R²</th>
<th>Variable</th>
<th>Associated BHI-2 scale</th>
<th>B</th>
<th>Wald, p-value</th>
<th>Odds ratio</th>
<th>Lower 95% CI for odds ratio</th>
<th>Upper 95% CI for odds ratio</th>
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<tbody>
<tr>
<td><strong>Acute pain patients</strong></td>
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<tr>
<td>91.7 (1), &lt;.001</td>
<td>81.3</td>
<td>0.364</td>
<td>Depression scale</td>
<td>Not applicable</td>
<td>0.12</td>
<td>190, &lt;.001</td>
<td>1.13</td>
<td>1.07</td>
<td>1.19</td>
</tr>
<tr>
<td>28.6 (1), &lt;.001</td>
<td>83.7</td>
<td>0.094</td>
<td>History of suicide attempt</td>
<td>Borderline</td>
<td>1.8</td>
<td>14.4, &lt;.001</td>
<td>5.9</td>
<td>2.4</td>
<td>14.9</td>
</tr>
<tr>
<td>23.0 (1), &lt;.001</td>
<td>85.9</td>
<td>0.070</td>
<td>Wanting to die because life is hard</td>
<td>Depression</td>
<td>2.2</td>
<td>22.4, &lt;.001</td>
<td>8.9</td>
<td>3.6</td>
<td>22.0</td>
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<tr>
<td>14.0 (1), &lt;.001</td>
<td>86.5</td>
<td>0.040</td>
<td>Dizziness</td>
<td>Somatic complaints</td>
<td>1.5</td>
<td>13.3, &lt;.001</td>
<td>4.4</td>
<td>2.0</td>
<td>9.7</td>
</tr>
<tr>
<td>9.3 (1), 0.002</td>
<td>88.0</td>
<td>0.026</td>
<td>Abused by a spouse or lover</td>
<td>Family dysfunction</td>
<td>1.5</td>
<td>12.6, &lt;.001</td>
<td>4.3</td>
<td>1.9</td>
<td>9.8</td>
</tr>
<tr>
<td>9.8 (1), 0.002</td>
<td>88.3</td>
<td>0.026</td>
<td>Symptom dependency scale</td>
<td>Not applicable</td>
<td>-0.1</td>
<td>10.2, 0.001</td>
<td>0.92</td>
<td>0.88</td>
<td>0.97</td>
</tr>
<tr>
<td>6.7 (1), 0.009</td>
<td>89.0</td>
<td>0.018</td>
<td>People anger me by being near them</td>
<td>Hostility</td>
<td>1.1</td>
<td>6.6, 0.01</td>
<td>2.9</td>
<td>1.3</td>
<td>6.5</td>
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<td><strong>Chronic pain patients</strong></td>
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<tr>
<td>74.9 (1), &lt;.001</td>
<td>77.1</td>
<td>0.272</td>
<td>Feeling empty and dead inside</td>
<td>Depression</td>
<td>2.1</td>
<td>33.6, &lt;.001</td>
<td>8.0</td>
<td>4.0</td>
<td>16.2</td>
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<tr>
<td>51.2 (1), &lt;.001</td>
<td>80.4</td>
<td>0.154</td>
<td>History of suicide attempt</td>
<td>Borderline</td>
<td>2.4</td>
<td>36.9, &lt;.001</td>
<td>11.0</td>
<td>5.1</td>
<td>24.0</td>
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<td>20.2 (1), &lt;.001</td>
<td>79.2</td>
<td>0.055</td>
<td>Self-confidence</td>
<td>Perseverance</td>
<td>-1.0</td>
<td>10.2, 0.001</td>
<td>0.36</td>
<td>0.19</td>
<td>0.67</td>
</tr>
<tr>
<td>16.8 (1), &lt;.001</td>
<td>81.5</td>
<td>0.043</td>
<td>Life is satisfactory</td>
<td>Depression</td>
<td>-1.3</td>
<td>14.4, &lt;.001</td>
<td>0.29</td>
<td>0.15</td>
<td>0.55</td>
</tr>
<tr>
<td>9.3 (1), 0.0002</td>
<td>82.7</td>
<td>0.023</td>
<td>I cannot stop bad habits</td>
<td>Perseverance</td>
<td>0.96</td>
<td>9.2, 0.002</td>
<td>2.6</td>
<td>1.4</td>
<td>4.8</td>
</tr>
</tbody>
</table>

BHI-2, Battery for Health Improvement 2; CI, confidence interval; df, degrees of freedom.

### Table 4  
Final model logistic regression results for significant independent variables with history of suicide attempt as the dependent variable for acute and chronic pain patients.

<table>
<thead>
<tr>
<th>Step&lt;sup&gt;e&lt;/sup&gt; (df), p-value</th>
<th>% of cases predicted correctly by the model</th>
<th>Step Nagelkerke R²</th>
<th>Variable</th>
<th>Associated BHI-2 scale</th>
<th>B</th>
<th>Wald, p-value</th>
<th>Odds ratio</th>
<th>Lower 95% CI for odds ratio</th>
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<tr>
<td><strong>Acute pain patients</strong></td>
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<tr>
<td>40.9 (1), &lt;.001</td>
<td>87.1</td>
<td>0.212</td>
<td>Getting angry makes me lose control</td>
<td>Hostility</td>
<td>1.9</td>
<td>13.6, &lt;.001</td>
<td>6.8</td>
<td>2.5</td>
<td>18.7</td>
</tr>
<tr>
<td>29.0 (1), &lt;.001</td>
<td>89.3</td>
<td>0.135</td>
<td>History of self-injury</td>
<td>Borderline</td>
<td>2.1</td>
<td>9.0, 0.003</td>
<td>8.2</td>
<td>2.1</td>
<td>32.4</td>
</tr>
<tr>
<td>22.7 (1), &lt;.001</td>
<td>88.7</td>
<td>0.097</td>
<td>Chronic maladjustment scale</td>
<td>Not applicable</td>
<td>0.10</td>
<td>16.2, &lt;.001</td>
<td>1.11</td>
<td>1.05</td>
<td>1.16</td>
</tr>
<tr>
<td>21.8 (1), 0.008</td>
<td>90.8</td>
<td>0.088</td>
<td>Pain range score</td>
<td>Not applicable</td>
<td>0.35</td>
<td>14.0, &lt;.001</td>
<td>1.42</td>
<td>1.18</td>
<td>1.71</td>
</tr>
<tr>
<td>9.5 (1), 0.003</td>
<td>92.3</td>
<td>0.036</td>
<td>Recent frequent suicide ideation</td>
<td>Depression</td>
<td>2.1</td>
<td>17.2, &lt;.001</td>
<td>7.9</td>
<td>3.0</td>
<td>20.9</td>
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<td><strong>Chronic pain patients</strong></td>
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<tr>
<td>46.3 (1), &lt;.001</td>
<td>83.9</td>
<td>0.199</td>
<td>History of self-injury</td>
<td>Borderline</td>
<td>2.4</td>
<td>24.2, &lt;.001</td>
<td>11.4</td>
<td>4.3</td>
<td>30.2</td>
</tr>
<tr>
<td>28.5 (1), &lt;.001</td>
<td>83.0</td>
<td>0.110</td>
<td>Survivor of violence scale</td>
<td>Not applicable</td>
<td>0.09</td>
<td>24.7, &lt;.001</td>
<td>1.09</td>
<td>1.05</td>
<td>1.13</td>
</tr>
<tr>
<td>8.9 (1), 0.003</td>
<td>85.3</td>
<td>0.032</td>
<td>Hearing voices others don't</td>
<td>Somatic complaints</td>
<td>1.8</td>
<td>11.9, 0.001</td>
<td>6.1</td>
<td>2.2</td>
<td>17.2</td>
</tr>
<tr>
<td>5.0 (1), 0.025</td>
<td>84.5</td>
<td>0.018</td>
<td>I normally have lots of energy</td>
<td>Borderline</td>
<td>-0.90</td>
<td>6.0, 0.014</td>
<td>0.41</td>
<td>0.20</td>
<td>0.84</td>
</tr>
<tr>
<td>6.1 (1), 0.014</td>
<td>85.9</td>
<td>0.022</td>
<td>Dizziness</td>
<td>Somatic complaints</td>
<td>-0.88</td>
<td>5.7, 0.017</td>
<td>0.42</td>
<td>0.20</td>
<td>0.86</td>
</tr>
</tbody>
</table>

BHI-2, Battery for Health Improvement 2; CI, confidence interval; df, degrees of freedom.
depression scales and items from the BHI-2 chronic maladjustment scale and pain range score. The final model chi-square was significant ($\chi^2 = 123.9[5], \ p < 0.001$), explained 57% of the variance in the dependent variable and classified 92% of the subjects correctly.

The final model (Table 4) identified five predictor variables for CPPs: BHI-2 survivor of violence scale and items from the BHI-2 borderline and somatic complaints scales. The final model chi-square was significant ($\chi^2 = 94.8[5], \ p < 0.001$), explained 38% of the variance in the dependent variable and classified 86% of the subjects correctly.

### 3.7 Final logistic regression models with significant independent variables with recent frequent suicide ideation as the dependent variable for APPs and CPPs

The final model (Table 5) identified five predictor variables for APPs: items from the BHI-2 borderline, depression and somatic complaints scales. The final model chi-square was significant ($\chi^2 = 83.5[4], \ p < 0.001$), explained 63% of the variance in the dependent variable and classified 97% of the subjects correctly.

The final model (Table 5) identified five predictor variables for CPPs: the depression scale of the BHI-2 and items from the somatic complaints, perseverance and hostility scales of the BHI-2. The final model chi-square was significant ($\chi^2 = 103.0[5], \ p < 0.001$) and explained 56% of the variance in the dependent variable according to Nagelkerke $R^2$. The model classified 94% of the subjects correctly.

### 3.8 Final logistic regression model with significant independent variables with having a suicide plan as the dependent variable for APPs and CPPs

The final model (Table 6) identified four predictor variables for APPs: items from the BHI-2 depression, hostility and borderline scales. The final model chi-square was significant ($\chi^2 = 83.5[4], \ p < 0.001$), explained 57% of the variance in the dependent variable and classified 95% of the subjects correctly.

The final model (Table 6) identified four predictor variables for CPPs: items from the BHI-2 scales of depression, somatic complaints, borderline and employment status. The final model chi-square was significant ($\chi^2 = 65.5[4], \ p < 0.001$), explained 50% of the variance in the dependent variable and classified 92% of the subjects correctly.
Supporting Information Table S5 provides a summary of the significant predictors in Tables 1–6 for APPs and CPPs for each suicidality item. It is to be noted that although some predictors overlapped for APPs and CPPs for individual suicide items, most did not. This indicates that predictor profiles for APPs and CPPs could differ.

4. Discussion

First, it is interesting to note that rehabilitation patients without pain appeared to endorse each of the suicide items at approximately the same frequency as CPPs (Supporting Information Table S3). This was an unexpected result which could be related to the small number of rehabilitation patients without pain. It is also possible that these patients are stressed by their injury (functionally), the medical system, the rehabilitation process, and have financial issues from not working. All of these issues could combine, resulting in depression which in turn would result to potential suicidality equalling the frequency of CPPs who generally have all these stressors plus pain. As such, this could be the explanation for this result.

This is the first demonstration that suicidality predictor variables differ between APPs and CPPs within each suicidality item (Supporting Information Table S5) supporting the concept that suicidality may differ by pain type. Additionally, predictor variables differed across the six suicidality items (Supporting Information Table S5), indicating that although the suicidality items are highly correlated to each other, they nevertheless tap different constructs. However, presently it is unclear what those constructs are. Demographic variables such as gender, etc., which have historically been linked with increased suicide risk in psychiatric patients and other groups (American Psychiatric Association, 2003), were not found to be predictive of any form of suicidality in APPs or CPPs. The only demographic variable found to be predictive (suicide plan – CPPs) was unemployment. These demographic results are also supported by previous pain literature. The reason for the difference between pain/non-pain groups as to demographic variables being predictive requires further study. In our study, this could be related to low power versus distinct relationships.

Although litigation, worker compensation status and personal injury status increase risk for some forms of suicidality in some pain patient groups (Fishbain et al., 2009b), in this study these variables did not predict any suicidality items. As these variables are demographic in nature, their lack of utility in predicting suicidality may be related to the general
inability of demographic variables to predict suicidality in pain patients.

Pain levels have previously been demonstrated to be predictive of suicidal ideation, passive suicidal ideation, suicide attempts and suicide completions (Introduction). In chronic low back pain patients, the rate of major depression has been shown to increase in a linear fashion with greater pain severity (Billings and Eddy, 1987) and major depression has been reported to be predictive of some forms of suicidality in CPPs (Introduction). Yet, one CPP study found no relationship between pain levels and suicide ideation (Smith et al., 2004b). In our study, pain levels were only predictive in APPs for one suicide item: history of suicide attempts. These results add to the confusion surrounding this variable, but indicate that pain levels may be predictive for some forms of suicidality in some pain groups. Our results could have been influenced by the fact that pain levels are not a stable construct. The patients’ ratings of pain are influenced by multiple factors including the length of time in pain which is a factor in our study.

Behaviour literature has concluded that patient’s suicidal ideas, suicide plans and suicide attempts are predictive for increased risk of suicide completion (American Psychiatric Association, 2003). Pain literature has not examined the impact of these variables on each other, but one study demonstrated an association between current suicide ideation and previous history of suicide attempts (Fisher et al., 2001). We have demonstrated that suicidality items are significantly intercorrelated and predictive of each other in both APPs and CPPs. Thus, these results support previous behaviour literature and in turn are supported by this literature. However, our results also demonstrate that just because a suicidality item correlates significantly with another item, it will not necessarily be the best predictor of that item. Also, higher correlations do not necessarily mean that the item will be predictive. Having a suicide plan is demonstrated in Table 6. Here, of the five suicidality items utilized to predict this item for CPPs, only history of suicide attempt and recent frequent suicide ideation were predictive. In addition, although recent frequent suicide ideation had the highest correlation (0.390) with having a suicide plan, history of suicide attempt had the second lowest correlation (0.254).

The behaviour suicide literature has also found a significant number of other variables to be associated with increased risk of suicidality (American Psychiatric Association, 2003; Sareen et al., 2005, 2007). According to our results, many of these same variables [functional status, depression, substance abuse, poor family relationships/lack of support, diagnosis of borderline syndrome, childhood physical abuse, anxiety, aggression/violence history, psychosis (hearing voices), previous history of self-injury (cutting self)] were predictive of some forms of suicidality in APPs and CPPs (American Psychiatric Association, 2003). Thus, again previous behaviour literature supports and is supported by our results. However, of these variables, only depression was previously identified as a suicidality predictor variable in the pain literature.

Some of our suicidality predictor variables (low perseverance/self-efficacy, chronic maladjustment) have not been identified in either the behaviour or pain literature. There is some indirect support in the pain literature for our finding of ‘somatic complaints’ being predictive. Suicidality is increased by the number of physical illnesses (Herring, 2009). Chronic spinal pain is in turn significantly associated with chronic physical conditions (Von Korff et al., 2005). Physical illnesses/chronic physical conditions translate into somatic symptoms. Thus, these studies may indirectly support this finding. However, identification of these variables as suicidality predictors will need to be replicated in later studies.

As only a small percentage of patients endorse some suicidality items (e.g., wanting to die because of pain in APPs), the models that we have built will not be applicable to all rehabilitation patients. However, some of the models that we have developed appear to predict some suicidality items at significantly better than the base rate. The concept of the base rate is demonstrated by examining a suicidality item. Of the APPs, 7.06% endorsed ‘having a suicide plan’. Then if one were to predict that no one would have a suicide plan, that prediction would be correct 92.94% of the time. Therefore, our model had to classify patients correctly at greater than 92.94% of the time. For this suicidality item for APPs, our model classified 95% of the patients correctly – only slightly better than the base rate. This was also the case for CPPs – ‘having a suicide plan’, APPs – ‘history of suicide attempts’, CPPs – ‘wanting to die because of pain’ and CPPs – ‘recent frequent suicide ideation’. For APPs – ‘wanting to die because of pain’, the model was no better than the base rate, and for APPs – ‘recent frequent suicide ideation’, the model was worse than the base rate. However, the models were significantly better than the base rates for the following suicidality items: ‘history of wanting to die’ (APPs and CPPs), ‘history of suicide attempts’ (CPPs) and ‘wanting to die because life is hard (APPs and CPPs).

If some of the models are no better than the base rate, what is the clinical utility of these models? These
models may be clinically useful in that they may describe APPs and CPPs who may be at risk for that form of suicidality. For example, the clinical portrait for the CPP at risk for having a suicide plan is as follows: a patient with recent frequent suicide ideation, a history of suicide attempts, who hears voices and is unemployed. Additionally, as a number of these models predicted suicide items significantly above the base rate, variables from these models could eventually be utilized to develop a suicidality predictor tool specifically for APPs and CPPs.

There are a number of potential confounders/limitations to the results of this study: First, the six suicide items under investigation were dichotomized. This procedure made it possible to apply commonly used statistical methods such as odds ratios to the data. Overall, this increased the clarity and interpretability of the results. We do not believe that this affected the distribution and broader psychometrics of these measures, although this is a possibility.

Second, our use of stepwise logistic regression in this study has both advantages and disadvantages. The advantage is that this method identifies the combination of variables that best predict the dependent variable. However, a weakness in this method is that if there are two independent variables of approximately equal predictive power, and if these two variables are strongly correlated, only one of these variables is likely to be included in the regression equation. Thus, stepwise regression methods may exclude variables that are significant predictors when other similar predictors are also present. This method, however, is commonly used but can lead to results that can be an artefact of the regression analysis. In addition, this type of analysis allows no implication for a time course relationship between the dependent and independent variables.

Third, there is a possibility for self-selection bias for entrance into the BHI-R study. As noted in the Methods section, the 777 rehabilitation patients were recruited from various clinics by posters/flyers, ensuring some random selection. However, this procedure did not preclude self-selection bias in entering/not entering the BHI-R study. Thus, this issue could have served as a potential confounder to the results of this study. Similarly, community patients and non-patients were also recruited by newspaper advertisements and posters. As such, for these groups also, self-selection bias could have occurred, potentially confounding the results of this study.

Fourth, our procedure by definition identified the CPP, but by selecting patients with pain levels greater than zero, it may have selected many patients with pain levels below 5/10. As such, our CPP patient sample may not have been representative of the clinical setting. However, as noted above, pain levels did not enter the CPP suicidality models. As such, we do not believe that this is a potentially significant confounder in applying these results to clinical CPP populations.

Fifth, a major issue in reference to the suicidality questions/items utilized is whether they represent distinct facets of suicidality or just quantify the magnitude of suicidality. As we have demonstrated that there are significant correlations between the six items, one could assume that they are to a considerable degree tapping into the same construct. Nevertheless, these items may differ by their ability to predict suicide completion risk. This is the way that psychiatry/psychology clinicians have been taught to evaluate various forms of suicidality for suicide completion risk (American Psychiatric Association, 2003). For example, items such as previous history of suicide attempts and having a suicide plan have been shown to be predictive of suicide completion (American Psychiatric Association, 2003), while such items as ‘waiting to die’ have not necessarily been. Such items are generally classified as passive suicidality with less risk for suicide completion (Fishbain et al., 2009b). As such, one could consider the items tested here as a sort of continuum on a magnitude scale for risk of suicide completion. If this is the case, then treating these items as different forms of suicidality and trying to predict each one could be premature. However, as these items have not been placed on a magnitude scale for predicting suicide completion, the approach here may have some clinical utility. For example, according to the results in Table 3, a CPP presenting with a history of wanting to die (passive suicidality) should be asked about previous suicide attempts (predict this item – Table 3). Affirmation here would then increase this CPP’s risk for suicide completion. It is to be noted that the analysis here does not advocate ignoring any of the items tested in the clinical evaluation of patients. On the contrary, the results speak to the interrelationship of these items with one another.

Sixth, the defining criterion for the distinction between acute and chronic utilized in this study was pain duration. This is well accepted in the pain literature. However, this does not mean that the condition is etiologically any different or that the patient knows that he/she has acute pain or chronic pain or that these groups differ in characteristics that affect suicidality. Thus, the selection and comparison of these groups for analysis could be premature. However, the fact that CPPs are statistically more likely to affirm three suicidality items (history of wanting to die,
history of suicide attempt, wanting to die because of pain) (Supporting Information Table S3) would indicate that the artificial time distinction is tapping different populations of pain patients. Also, when predictor variables for the six suicidality items are compared between APPs and CPPs (Supporting Information Table S5), some predictor variables within each suicidality item overlap but the majority does not. As such, the division of the subjects into APPs and CPPs may be valid.

Seventh, it is possible that our community healthy and especially community patient groups contained some patients with pain. Thus, this could then have confounded some of the comparisons performed in Supporting Information Table S3. However, it is to be noted that this paper is not about rates or comparisons for suicidality affirmation in APPs versus CPPs but is about trying to predict these types of suicidality in these two groups. As such, this issue does not serve as a confounder to these predictions.

Eighth, endorsement of a history of suicide attempts was high with our rehabilitation patients. It is unclear whether this could have occurred because of some self-selection bias in registering in the tertiary rehabilitation facilities from which the patients were recruited. Thus, the predictor significant variables for this suicide item should be interpreted with caution.

What should be the future research based on these results? The golden grail of this research is to be able to predict actual suicide completion. Because actual suicide completion is an extremely rare event, such an endeavour would require either a large prospective study or a very large retrospective study trying to identify predictors of suicide completion. In terms of retrospective studies, it has been established that the actual presence of chronic pain is predictive of suicide completion (Fishbain, 1999; Fishbain et al., 2009b). Generally, information available in retrospective studies of suicide completers is sparse and invariably does not contain the kind of variables analysed here. However, the variables found to be significant predictors here could be utilized in a template fashion in order to identify variables that should be looked for in these suicide deaths. Similarly, if one was to design a prospective study of suicide completion in CPPs, the items identified here could serve as a template for variables to identify for presence/absence. If either of these studies were performed with meaningful identification of variables, then one could perhaps develop a suicide risk stratification model with personalized treatment/intervention based on stratification.

5. Conclusions

Suicidality predictor variables differ between APPs and CPPs and differ for different forms of suicidality. In addition, different forms of suicidality are predictive of each other. In contrast to non-pain behaviour patients, demographic variables are not predictive of suicidality in APPs and CPPs while some identified variables appear to be unique to pain patients.

References


Fishbain DA, Bruns D, Disorbio JM, Lewis JE. What are the variables that are associated with the patient’s wish to sue

**Supporting Information**

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Specific and non-specific types of pain diagnosed as a percentage of the total rehabilitation group (n = 777) (some patients with more than one diagnosis).

**Table S2.** List of additional variables collected in the BHI-R data set.

**Table S3.** Number and percentage of subjects endorsing suicide ideation or suicide history items.

**Table S4.** Phi correlation coefficients for APPs (above the diagonal) and CPPs (below the diagonal).

**Table S5.** Summary of variables found to be significant predictors for the six suicidality items for acute pain patients (A) and chronic pain patients (C).

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