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Are some ways of defining chronic low back pain more indicative of future back pain than others?

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3 1 **Title:** Are some ways of defining chronic low back pain more indicative of future back pain than
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5 2 others?

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8 3 **Running head:** Performance of chronic back pain measures

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3 14 Dear Editor,
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5 15 **Introduction:**
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8 16 Low-back pain (LBP) is one of the leading causes of years lived with disability,¹ with
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10 17 chronic low-back pain (CLBP) representing most of the costs and disability among those with
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12 18 LBP.² However, the lack of a consistent definition for CLBP makes it difficult to compare
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14 19 different studies.³ Given that the term CLBP is used as a prognostic indicator, this study assessed
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16 20 which patient-reported definition of CLBP provides the best indication of CLBP and high-impact
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18 21 back pain 6 months later for adults who report LBP at baseline.
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21 22 **Methods:**
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24 23 We studied adults who responded "Yes, I currently have this condition" to the question
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26 24 "Do you currently have back pain?" at baseline in two online panels: 1) Amazon Mechanical
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28 25 Turk (MTurk), a convenience panel of workers who participate in the Amazon online MTurk
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30 26 marketplace;⁴ and 2) KnowledgePanel (KP), the oldest and largest probability-based online panel
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32 27 in the US.⁵ We identified those who met one or more of four definitions of CLBP at baseline:³
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- 35 28 • **3-month duration definition:** Response of at least 3 months or more to "how long has
36
37 29 LBP been an ongoing problem for you?"
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39 30 • **Research Task Force (RTF)⁶ definition:** Responses of at least 3-months or more to
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41 31 "How long has LBP been an ongoing problem for you?" and at least half the days in the
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43 32 past 6 months or more to "How often has your LBP been an ongoing problem?"
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45 33 • **Provider identified:** Response of "Yes" to "Has a health provider told you that your
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47 34 back pain is chronic?"
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49 35 • **Individual identified:** Response of "Yes" to "Do you think your back pain is chronic?"
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3 36 High-impact pain was defined in two ways: a score of grade 2 or higher on the Graded
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5 37 Chronic Pain Scale (GCPS), or responding “most days” or “every day” to “Over the past 3
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8 38 months, how often did pain limit your life or work activities?”⁷⁻⁹
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10 39 For each CLBP definition at baseline, we calculated its sensitivity (ability to identify all
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12 40 those with condition), specificity (ability to identify those without condition), Youden index
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14 41 (balance of sensitivity and specificity assuming equal weight for each),¹⁰ positive predictive
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16 42 value (PPV, ability to identify a true positive among screener positives), negative predictive
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18 43 value (NPV, ability to identify a true negative among screener negatives), and accuracy
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20 44 (percentage of correct predictions) in predicting LBP and high-impact pain 6 months later.
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23 45 **Results:**

26 46 We included 827 individuals in the MTurk sample and 1,235 in the KP sample (see
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28 47 **Table 1**). The MTurk sample was younger, more likely to be non-Hispanic, more educated, and
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30 48 more likely to have high-impact pain at baseline than the KP sample. Over 90% in each sample
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32 49 met at least one definition of CLBP at baseline. In both samples, the CLBP definition most often
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34 50 met was 3-month duration (~90%), and the least common was provider-identified (~33%). While
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36 51 meeting at least one definition of CLBP was not significantly different between samples, the
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38 52 proportion of those meeting the RTF ($p<0.001$) and individual-identified ($p=0.003$) definitions of
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40 53 chronic pain were higher among MTurk participants while meeting the provider-identified
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42 54 ($p=0.030$) definition was higher among KP participants. High-impact pain in MTurk (KP) was
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44 55 53% (44%) at baseline and 47% (50%) 6-months later.
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49 56 Measures of the 6-months predictive power of the different CLBP definitions at baseline
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51 57 were similar between the MTurk and KP datasets (see **Table 2**). At least one CLBP definition
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53 58 was a better-than-chance indicator of future back pain according to most of these measures
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3 59 except the PPV for future activity limitation high-impact pain where no definition did better than
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5 60 50%. Each definition, other than patient-identified, was best at identifying future back pain
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8 61 according to several measures. The most sensitive predictor was the 3-month duration definition,
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10 62 while the provider-identified definition was the most specific. The provider-identified definition
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12 63 had the highest PPV for 6-month LBP and high-impact pain, whereas the 3-month definition had
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14 64 the highest NPV for 6-month LBP, and the RTF definition had the highest NPV for 6-month
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16 65 high-impact pain. The RTF definition also had the highest Youden index for 6-month LBP and
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18 66 GCPS high-impact pain, whereas the provider-identified definition had the highest Youden index
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20 67 for activity limitation high-impact pain. The 3-month definition was the most accurate at
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22 68 identifying 6-month LBP but was the least accurate for predicting high-impact pain at 6-months.
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26 69 **Discussion:**

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28 70 Different definitions of chronic low back pain are better at indicating future pain
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30 71 according to a variety of measures. This study provides guidance to clinicians and researchers as
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32 72 to the implications of using each CLBP definition.
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35 73 In choosing a definition of CLBP to use clinicians and researchers must balance the need
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37 74 for overall accuracy and sensitivity and specificity. If identifying all those likely to have future
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39 75 back pain is most important — i.e., there is a substantial cost to missing some of them (Type II
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41 76 error), then the focus should be on maximizing sensitivity. If it is most important to minimize
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43 77 those categorized as having CLBP who won't have future pain — i.e., there is a substantial cost
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45 78 to someone being told they have CLBP when they don't (Type I error), the focus should be on
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47 79 specificity. If these costs are equal, the Youden index should be used. If it is most important to
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49 80 be accurate in your indicator of future pain among those categorized as having CLBP, then the
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51 81 focus should be on PPV, and if it is most important to be accurate in your indicator of no future
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3 82 pain among those categorized as not having CLBP, then the focus should be on NPV. If accuracy
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5 83 in both directions is equally important, then use overall accuracy to choose your CLBP
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8 84 definition. Finally, when choosing a definition clinicians and researchers also must decide
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10 85 whether the goal is to identify those with future LBP or future high-impact pain.
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12 86 Our study has limitations. Data were self-report and from online samples. The MTurk
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14 87 sample (a convenience panel) may not be representative of the general population. However, the
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17 88 KP sample was designed to be representative of the U.S. population. The similarity seen in the
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19 89 results in the two samples provides support for the findings.
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26 92 Herman – no conflict
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Table 1: Characteristics of Study Participants

| | MTurk | KP |
|---|--------------|-------------|
| Total respondents (N) | 827 | 1235 |
| Age*** [mean (SD)] | 43 (12) | 55 (17) |
| Female [N (%)] | 457 (55%) | 644 (52%) |
| Hispanic** [N (%)] | 54 (6%) | 126 (10%) |
| Race | | |
| White [N (%)] | 700 (85%) | 1,023 (83%) |
| Black [N (%)] | 71 (9%) | 99 (8%) |
| Asian [N (%)] | 67 (8%) | 39 (3%) |
| Multiracial [N (%)] | 30 (4%) | 63 (5%) |
| Other [N (%)] | 21 (2%) | 11 (1%) |
| Education*** | | |
| Less than HS [N (%)] | 3 (0.4%) | 87 (7%) |
| HS or equivalent [N (%)] | 91 (11) | 346 (28%) |
| More than HS [N (%)] | 733 (89%) | 802 (65%) |
| Met at least one definition of chronicity at baseline [N (%)] | 774 (94%) | 1134 (92%) |
| 3-month [N (%)] | 756 (91%) | 1117 (90%) |
| RTF*** [N (%)] | 549 (66%) | 692 (56%) |
| Individual** [N (%)] | 524 (63%) | 701 (57%) |
| Provider* [N (%)] | 258 (31%) | 442 (36%) |
| Respondents with low back pain at 6-months [N (%)] | 663 (80%) | 962 (78%) |
| Those with low back pain at 6 months who met at least one definition of chronic low back pain [N (%)] | 643 (97%) | 922 (96%) |
| High-impact pain at baseline*** [N (%)] | 352 (53%) | 420 (44%) |
| High-impact pain at 6-months [N (%)] | 311 (47%) | 480 (50%) |

Note: Significance test results (*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$)

HS = High school; KP = data collected from Ipsos's KnowledgePanel; MTurk = data collected using Amazon's Mechanical Turk; RTF = NIH Pain Consortium Research Task Force.

Table 2: Prediction of low back pain and high-impact pain at 6 months by different definitions of chronic low back pain at baseline

| | Sensitivity (TP/(TP+FN)) | | Specificity (TN/(FP+TN)) | | Youden Index (Sensitivity +Specificity-1) | | PPV (TP/(TP+FP)) | | NPV (TN/(FN+TN)) | | Accuracy (TP+TN)/ (TP+FP+FN+TN)) | |
|---|-----------------------------|---------------|-----------------------------|---------------|---|-------------|---------------------|---------------|---------------------|---------------|--|---------------|
| | MTurk | KP | MTurk | KP | MTurk | KP | MTurk | KP | MTurk | KP | MTurk | KP |
| Prediction of low back pain at 6 months | | | | | | | | | | | | |
| 3-months | 95.00% | 94.50% | 23.60% | 23.80% | 0.19 | 0.18 | 83.33% | 81.38% | 53.52% | 55.08% | 81.10% | 78.9% |
| RTF | 71.50% | 64.60% | 55.60% | 74.00% | 0.27 | 0.39 | 86.34% | 89.74% | 32.01% | 37.20% | 68.40% | 66.60% |
| Patient definition | 68.80% | 64.80% | 58.40% | 71.40% | 0.27 | 0.36 | 87.02% | 88.87% | 31.02% | 36.52% | 66.80% | 66.20% |
| Provider definition | 36.40% | 42.20% | 89.40% | 86.80% | 0.26 | 0.29 | 93.41% | 91.86% | 25.31% | 29.89% | 46.70% | 52.10% |
| Prediction of high-impact pain at 6 months using GCPS | | | | | | | | | | | | |
| 3-months | 95.18% | 96.46% | 5.11% | 7.47% | 0 | 0.04 | 46.98% | 50.94% | 54.55% | 67.92% | 47.36% | 51.87% |
| RTF | 84.89% | 78.13% | 40.34% | 48.96% | 0.25 | 0.27 | 55.70% | 60.39% | 75.13% | 69.21% | 61.24% | 63.51% |
| Patient definition | 79.10% | 74.58% | 40.34% | 45.02% | 0.19 | 0.2 | 53.95% | 57.46% | 68.60% | 64.01% | 58.52% | 59.77% |
| Provider definition | 49.84% | 53.75% | 75.57% | 69.29% | 0.25 | 0.23 | 64.32% | 63.55% | 63.03% | 60.07% | 63.50% | 61.54% |
| Prediction of high-impact pain at 6 months using pain limitation | | | | | | | | | | | | |
| 3-months | 95.62% | 96.05% | 5.13% | 5.86% | 0.01 | 0.02 | 20.79% | 18.70% | 81.82% | 86.79% | 23.83% | 22.45% |
| RTF | 89.05% | 84.18% | 33.08% | 39.87% | 0.22 | 0.24 | 25.74% | 23.99% | 92.06% | 91.79% | 44.65% | 48.02% |
| Patient definition | 81.02% | 81.36% | 34.41% | 38.98% | 0.15 | 0.2 | 24.34% | 23.11% | 87.44% | 90.27% | 44.04% | 46.78% |
| Provider definition | 55.47% | 63.84% | 68.63% | 62.68% | 0.24 | 0.27 | 31.54% | 27.83% | 85.55% | 88.49% | 65.91% | 62.89% |

FN = False negative; FP = False positive; GCPS = Graded Chronic Pain Scale; KP = data collected from Ipsos's KnowledgePanel; MTurk = data collected using Amazon's Mechanical Turk; NPV = Negative predictive value; PPV = Positive predictive value; RTF = NIH Pain Consortium Research Task Force; TN = True negative; TP = True positive; **Bold** indicates the largest value in each column.