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Validation of neuropathic pain assessment tools among Chinese patients with painful diabetic peripheral neuropathy

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ABSTRACT

Objective: This study aims to evaluate the reliability and validity of neuropathic pain assessment tools among Chinese patients with painful diabetic peripheral neuropathy (PDPN).

Methods: One hundred patients with PDPN and 70 patients with non-neuropathic pain were recruited from five grade III general hospitals in Guangzhou. Pain was assessed using the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS), Douleur Neuropathique 4 questionnaire (DN4), and Brief Pain Inventory for Painful Diabetic Peripheral Neuropathy (BPI-DPN). Reliability was evaluated by internal consistency of the Cronbach’s α coefficient and Guttman split-half. Construct validity was analyzed by factor analysis and Spearman correlation coefficients. Sensitivity and specificity were also assessed.

Results: The Cronbach’s α coefficients of the LANSS, DN4, and BPI-DPN were 0.735, 0.750, and 0.898, respectively. The Guttman split-half coefficients of the LANSS, DN4, and BPI-DPN were 0.660, 0.726, and 0.849, respectively. The cumulative contributions of the LANSS, DN4, and BPI-DPN to the total variance were 61.945%, 57.010%, and 66.056%, respectively. The items of the LANSS, DN4, and BPI-DPN presented high factorial loads, ranging from 0.387 to 0.841, 0.137 to 0.948, and 0.487 to 0.953, respectively. The LANSS and DN4 exhibited sensitivities of 58.0% and 82.7%, respectively, and specificity of 97.1%. Reliability was evaluated by internal consistency of the Cronbach’s α coefficient and Guttman split-half. Construct validity was analyzed by factor analysis and Spearman correlation coefficients. Sensitivity and specificity were also assessed.

Conclusions: The LANSS or DN4 can be used to detect neuropathic pain in Chinese patients with PDPN. The BPI-DPN can be employed to monitor the effectiveness of pain intervention.

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1. Introduction

Diabetes mellitus (DM) is a common chronic disease and could lead to diabetic peripheral neuropathy (DPN) [1]. DPN could affect up to one-third of adults with diabetes [2]. Symptoms of DPN include numbness, burning, pins and needles, and sometimes allodynia. Painful diabetic peripheral neuropathy (PDPN) is caused by abnormalities of the peripheral nervous system in patients with diabetes [3]. The prevalence of PDPN varies from 14.0% to 65.3% [4,5]. China has the highest human population worldwide; of which, approximately 114 million patients suffer from DM [6]. However, the prevalence of PDPN in China has been rarely investigated.

PDPN affects the quality of life of patients, and the pain severity of this disease is associated with anxiety and depression [2,7,8]. Patients with PDPN exhibit significantly higher healthcare resource utilization and costs than patients with diabetes only [9]. Early detection of the presence of PDPN contributes to treatment outcome. In addition, effective pain assessment tools can be used to diagnose PDPN.

PDPN is difficult to diagnose. Gold diagnostic criteria for PDPN have not been established clinically. Assessment tools can be used to distinguish PDPN from other types of pain. Several neuropathic pain assessment tools are available and include the most widely used Leeds Assessment of Neuropathic Symptoms and Signs (LANSS), Douleur Neuropathique 4 questionnaire (DN4), and Brief Pain Inventory for Painful Diabetic Peripheral Neuropathy (BPI-DPN). The LANSS was developed by Bennett [10] and has been translated into Portuguese [11,12], Spanish [13,14], Turkish [15,16], and other languages. The Chinese version of the LANSS was translated and validated by Li et al. [17]. This version is reliable and valid. The DN4 was designed by a French pain expert group in 2005 [18] and has been translated into Arabic [19], Dutch [20], Greek [21], and several other languages. However, the Chinese version of the DN4 has not been reported. The LANSS and DN4 are used to differentiate neuropathic pain from non-neuropathic pain, but not for Chinese patients with PDPN specifically. The Brief Pain Inventory (BPI) was developed by Cleeland and Ryan [22], and the Chinese version of this tool is widely used to assess acute, chronic, and cancer pain. The BPI-DPN was revised by Zelman et al. [23] to assess patients with PDPN, but this version has not been reported in China.

This study aims to evaluate the reliability and validity of the LANSS, DN4, and BPI-DPN among Chinese patients with PDPN.

2. Methods

2.1. Sample

A convenience sample was recruited at inpatient and outpatient departments of endocrinology, inpatient department of pain, and outpatient department of orthopedics from five grade III general hospitals in Guangzhou from May 2014 to January 2015. Inclusion criteria were as follows: a) age ≥ 18; b) complaint of pain for over 3 months (persistent and/or recurrent pain); c) having one of the following diagnosis: neuropathic pain (PDPN), or non-neuropathic pain (low back pain, myofascial pain syndrome, ankylosing spondylitis, shoulder arthritis, headache, osteoporosis, carpal tunnel syndrome, rib cartilage inflammation, osteoarthritis, etc.); and d) willing and able to complete the questionnaire. The exclusion criteria included the presence of neuropathic pain from other causes or with mixed pain, history of foot ulcers or severe comorbidities or lower limb amputation, and inability to communicate and complete the questionnaire.

Based on sample size estimation, 100 subjects were required for a two-sided test with 80% power of the test (1 − β) at a significance level α of 0.05. In previous studies, sample sizes ranged from 42 to 123 and from 52 to 80 for neuropathic pain and non-neuropathic pain, respectively. On the basis of sample size estimation and previous studies, the sample sizes for neuropathic pain (PDPN) and non-neuropathic pain used for the present study were 100 and 70, respectively.

2.2. Measures

2.2.1. Leeds assessment of neuropathic symptoms and signs (LANSS)

The LANSS [10] was developed to distinguish neuropathic pain from nociceptive pain. The LANSS consists of pain questionnaire and sensory testing with seven items, and the highest overall score is 24. Pain questionnaire includes sensations, such as pricking, tingling, pins and needles, skin discoloration, light touch pain, electric shocks, jumping and bursting, and feeling of altered skin temperature, including hot and burning. Sensory testing includes allodynia and altered pin-prick threshold. If the pain symptom is consistent with the description, the subjects answer “yes,” and the item is scored 5, 5, 3, 2, 1, 5, and 3, respectively. If the pain symptom is inconsistent, the subjects answer “no,” and the item is scored 0. The cut-off value is 12. If the total score is ≥12, neuropathic mechanisms could contribute to the pain experienced by the patient. The Chinese version of the LANSS used in this study was translated by Li et al. with a Cronbach’s α value of 0.824; this version exhibits high sensitivity, specificity, and positive and negative predictive values (>80%) [17].

2.2.2. Douleur neuropathique 4 questionnaire (DN4)

The DN4 [18] consists of four questionnaires in two parts, namely, interview and examination, of the patient with a total of 10 items. DN4-interview questions include burning, painful cold, electric shocks, tingling, pins and needles, numbness, and itching. Examination of the patient includes hypoesthesia to touch, hypoesthesia to prick, and brushing. Each item is scored “yes” or “no.” Each “yes” item is scored 1, and “no” is scored 0, with a total possible score of 10. The cut-off value is 4. Total score ≥4 indicates neuropathic pain. The Chinese version of the DN4 was translated by the first author and another nursing master candidate and then back-translated by the corresponding author.

2.2.3. Brief pain inventory for painful diabetic peripheral neuropathy (BPI-DPN)

The Brief Pain Inventory (BPI) [22] includes pain intensity and pain interference on a 0–10 numeric rating scale (NRS). Pain
intensity is assessed as worst pain, least pain, average pain in the last 24 h, and current pain. The pain interference includes general activity, mood, walking ability, normal work, relations to other people, sleep, and enjoyment of life during the past 24 h. The BPI-DPN is a revision of the BPI to phrase all items with “due to diabetes.” The BPI-DPN was used to assess the pain intensity and pain interference of patients with PDPN in this study.

2.3. Study procedures

Human subject ethics review was approved by the institutional review boards. Two master students and one registered nurse were trained to conduct assessments independently. A training session was provided, where information on pain assessment, definition of neuropathic pain, clinical signs and symptoms of patients with PDPN, and use of the three study tools was discussed to the data collectors. Patients who met the inclusion criteria were approached voluntarily, and informed consent was obtained prior to participation. The same person performed data collection, and all the tools were completed at one time in the same order (LANSS, DN4, and BPI-DPN).

Demographic characteristics (gender, age, and education), diagnosis (diabetes, pain-related diseases, and other chronic diseases), life style and self-management (smoking and drinking), and physical examination results including height, weight, and blood pressure, were collected. Data on duration of diabetes, family history of diabetes, history of hypertension, most recent laboratory test results (blood glucose and blood lipids), and clinical treatment regimen were also collected from patients with PDPN.

In this study, we defined DPN as “having diagnosis of DPN from the medical history, or the presence of neuropathic symptoms/signs, or abnormal results of monofilament test.” PDPN was defined as average daily pain intensity of ≥4 (moderate or severe pain) in the 0–10 numeric rating scale in the legs including the feet or hands in the last 48 h or when patients were taking medication for their current pain because of DPN [24]. The diagnoses of the non-neuropathic pain and DPN were based on patient’s medical record by the physician. PDPN was confirmed through clinical examination.

2.4. Statistical analysis

Analyses were performed using SPSS 13.0. Demographic and clinical information were described using mean (standard deviation, SD) for quantitative variables and percentage for categorical variables. Comparisons between quantitative data used independent sample t-test, and categorical data were analyzed using Chi-square test. Reliability was evaluated by internal consistency of Cronbach’s α coefficient and Guttman split-half. Construct validity was analyzed by factor analysis (principal component analysis) and Spearman correlation coefficients. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s test of sphericity were used for factor analysis. Sensitivity and specificity were also assessed.

3. Results

3.1. Subjects

A total of 170 patients aged 23–90 years, with a mean age of 59.67 ± 12.77 years, were recruited in this study; of the patients, 70 were male (41.2%), and 100 were female (58.8%). One hundred (58.8%) and 70 (41.2%) patients suffered PDPN and non-neuropathic pain, respectively. In patients with non-neuropathic pain, the diagnoses included osteoarthritis (36, 51.4%), low back pain (16, 22.9%), shoulder arthritis (5, 7.1%), myofascial pain syndrome (5, 7.1%), rib cartilage inflammation (2, 2.9%), carpal tunnel syndrome (2, 2.9%), headache (2, 2.9%), ankylosing spondylitis (1, 1.4%), and osteoporosis (1, 1.4%). Among patients with PDPN, 22 had a family history of diabetes, 33 with hypertension, and 5 had coronary heart diseases. Regarding treatment for diabetes, 22 of the patients had oral drugs, 20 were administered with insulin, and 56 were given with oral drugs and insulin. The demographic and clinical data of the patients are shown in Tables 1 and 2.

In patients with PDPN, the frequency of positive items of the LANSS ranged from 28.0% to 99.0%, with top items, such as sensations like pricking, tingling, pins and needles (99.0%); electric shocks, jumping, and bursting (93.0%); and altered pin-prick threshold (59.0%). The frequency of positive items of the DN4 ranged from 14.3% to 82.7%, with top items, such as pins and needles (82.7%), tingling (81.6%), electric shocks (76.5%), and numbness (72.4%). In patients with non-neuropathic pain, the frequency of positive items of the LANSS and DN4 ranged from 0 to 18.6% and 1.4–22.9%, respectively. This result is significantly lower than that in patients with PDPN (P < 0.001).

3.2. Reliability

The Cronbach’s α coefficient of the LANSS was 0.735 in patients with PDPN, and the Guttman split-half coefficient was 0.660. If each item were deleted, the Cronbach’s α of the LANSS would range from 0.657 to 0.746.

<table>
<thead>
<tr>
<th>Item</th>
<th>PDPN (n = 100)</th>
<th>NNP (n = 70)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>59.32 ± 10.44</td>
<td>60.16 ± 15.52</td>
<td>0.694</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.013</td>
</tr>
<tr>
<td>Male (%)</td>
<td>49 (49.0)</td>
<td>21 (30.0)</td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>51 (51.0)</td>
<td>49 (70.0)</td>
<td></td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.63 ± 0.09</td>
<td>1.59 ± 0.74</td>
<td>0.006</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.09 ± 11.09</td>
<td>59.24 ± 9.24</td>
<td>0.076</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.38 ± 3.35</td>
<td>23.39 ± 3.21</td>
<td>0.982</td>
</tr>
<tr>
<td>Education</td>
<td>0.883</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤8 years (%)</td>
<td>51 (52.6)</td>
<td>37 (52.9)</td>
<td>0.872</td>
</tr>
<tr>
<td>&gt;8 years (%)</td>
<td>46 (47.4)</td>
<td>33 (47.1)</td>
<td></td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>32 (32.3)</td>
<td>6 (8.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Drinking (%)</td>
<td>34 (34.3)</td>
<td>6 (8.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>NRS scores</td>
<td>5.06 ± 2.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BMI, body mass index; NNP, non-neuropathic pain; PDPN, painful diabetic peripheral neuropathy; NRS, numeric rating scale.
The Cronbach's $\alpha$ coefficient of the DN4 was 0.750, and the Guttman split-half coefficient was 0.726. If each item were deleted, the Cronbach's $\alpha$ of the DN4 would range from 0.680 to 0.769.

The Cronbach's $\alpha$ coefficient of the BPI-DPN was 0.898, and the Guttman split-half coefficient was 0.849. If each item were deleted, the Cronbach's $\alpha$ of the BPI-DPN would range from 0.882 to 0.896.

### 3.3. Validity

The results showed the suitability of the LANSS (KMO value = 0.735) and the significance of the adopted procedure (Bartlett's test with a value of 386.435, $P < 0.001$). The principal component analysis of the LANSS showed that the eigenvalues of two components were greater than 1, and the cumulative proportion of variance explained was 61.945%. The items of the LANSS presented high factorial loads, ranging from 0.387 to 0.841. The lowest factorial load was “skin discoloration” (0.387) (Table 3). The highest Spearman correlation coefficient between the items was “pins and needles” (0.794), and the lowest item was “painful cold” (0.226).

The results showed the suitability of the DN4 (KMO value = 0.743) and the significance of the adopted procedure (Bartlett's test with a value of 388.345, $P < 0.001$). The principal component analysis of the DN4 indicated that the eigenvalues of three components were greater than 1, and the cumulative variance accounted for 57.010% of the total variance. The items of the DN4 presented high factorial loads, ranging from 0.137 to 0.948. The lowest factorial load was “painful cold” (0.137) (Table 4). The highest Spearman correlation coefficient between the items was “pins and needles” (0.794), and the lowest item was “painful cold” (0.226).

The results using the BPI-DPN showed that patients with PDPN experienced considerable pain, which affected their lives. For pain intensity, the mean scores of the worst, least, average, and current pain were 7.18 ± 2.54, 7.29 ± 2.78, respectively. The majority levels of the worst pain, least pain, average pain in the past 24 h, and current pain were higher than the medium level. Pain interference in patients increased with pain intensity.

### Table 2 – Clinical information of patients with PDPN.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of diabetes (years)</td>
<td>9.30 ± 6.84</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>136.80 ± 19.38</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>80.85 ± 11.56</td>
</tr>
<tr>
<td>Fasting plasma glucose (mmol/L)</td>
<td>8.09 ± 2.98</td>
</tr>
<tr>
<td>2 h postprandial plasma (mmol/L)</td>
<td>11.68 ± 4.17</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>8.71 ± 2.29</td>
</tr>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td>4.90 ± 1.30</td>
</tr>
<tr>
<td>Triglycerides (mmol/L)</td>
<td>1.98 ± 1.61</td>
</tr>
<tr>
<td>LDL-cholesterol (mmol/L)</td>
<td>2.82 ± 0.99</td>
</tr>
<tr>
<td>HDL-cholesterol (mmol/L)</td>
<td>1.26 ± 0.69</td>
</tr>
</tbody>
</table>

PDPN, painful diabetic peripheral neuropathy; LDL, low density lipoprotein; HDL, high density lipoprotein.

The results showed the suitability of the LANSS (KMO value = 0.735) and the significance of the adopted procedure (Bartlett's test with a value of 386.435, $P < 0.001$). The principal component analysis of the LANSS showed that the eigenvalues of two components were greater than 1, and the cumulative variance accounted for 66.056% of the total variance. The items of the BPI-DPN presented high factorial loads, ranging from 0.487 to 0.953 (Table 5).

The sensitivities of the LANSS ($\geq$12) and DN4 ($\geq$4) were 58.0% and 82.7%, respectively. The specificity of both tests was 97.1%.

### 3.4. Pain severity and pain interference in patients with PDPN

The results using the BPI-DPN showed that patients with PDPN experienced considerable pain, which affected their lives. For pain intensity, the mean scores of the worst, least, average, and current pain were 7.18 ± 1.70, 4.05 ± 2.34, 5.70 ± 1.76, and 5.06 ± 2.35, respectively. For pain interference, the mean scores for general activity, mood, walking ability, normal work, relations with other people, sleep, and enjoyment of life were 6.57 ± 2.67, 6.05 ± 2.53, 6.62 ± 2.79, 6.88 ± 3.05, 5.03 ± 2.54, 7.29 ± 2.15, and 6.40 ± 2.78, respectively. The majority levels of the worst pain, least pain, average pain in the past 24 h, and current pain are higher than the medium level. In addition, the pain interference in patients increased with pain intensity.

### 4. Discussion

The findings show that the LANSS, DN4, and BPI-DPN could be used for Chinese patients with PDPN.

In previous studies, the Cronbach's $\alpha$ coefficients of the LANSS varied in different samples, as follows: Portuguese, 0.67 [11] and 0.78 [12]; and Chinese, 0.82 [17]. Similar to previous studies, the present study showed that the Cronbach's $\alpha$ coefficient of the LANSS in patients with PDPN was 0.735. For the DN4, the Cronbach's $\alpha$ coefficient was 0.750, which is lower.

### Table 3 – Factor loading matrix of LANSS after rotation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pricking, tingling, pins, and needles</td>
<td>0.841</td>
<td>0.323</td>
</tr>
<tr>
<td>Skin discoloration</td>
<td>0.387</td>
<td></td>
</tr>
<tr>
<td>Light touch pain</td>
<td></td>
<td>0.790</td>
</tr>
<tr>
<td>Electric shocks, jumping, and bursting</td>
<td>0.800</td>
<td></td>
</tr>
<tr>
<td>Feeling of altered skin temperature</td>
<td>0.417</td>
<td></td>
</tr>
<tr>
<td>Allodynia</td>
<td>0.806</td>
<td></td>
</tr>
<tr>
<td>Altered pinprick threshold</td>
<td>0.497</td>
<td></td>
</tr>
</tbody>
</table>

LANSS, Leeds assessment of neuropathic symptoms and signs.

### Table 4 – Factor loading matrix of DN4 after rotation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning</td>
<td>0.156</td>
<td>0.181</td>
<td>0.724</td>
<td></td>
</tr>
<tr>
<td>Painful cold</td>
<td>0.107</td>
<td>0.137</td>
<td></td>
<td>0.383</td>
</tr>
<tr>
<td>Electric shocks</td>
<td>0.726</td>
<td>0.203</td>
<td>0.112</td>
<td></td>
</tr>
<tr>
<td>Tingling</td>
<td>0.559</td>
<td>0.466</td>
<td>0.286</td>
<td></td>
</tr>
<tr>
<td>Pins and needles</td>
<td>0.709</td>
<td>0.150</td>
<td>0.395</td>
<td></td>
</tr>
<tr>
<td>Numbness</td>
<td>0.242</td>
<td>0.948</td>
<td>0.102</td>
<td></td>
</tr>
<tr>
<td>Itching</td>
<td></td>
<td>0.283</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypoesthesia to touch</td>
<td>0.215</td>
<td></td>
<td>0.484</td>
<td></td>
</tr>
<tr>
<td>Hypoesthesia to prick</td>
<td>0.101</td>
<td>0.157</td>
<td>0.551</td>
<td></td>
</tr>
<tr>
<td>Brushing</td>
<td>0.174</td>
<td>0.111</td>
<td>0.585</td>
<td></td>
</tr>
</tbody>
</table>

DN4, Douleur neuropathique 4 questionnaire.

(0.137) (Table 4). The highest Spearman correlation coefficient between the items was “pins and needles” (0.794), and the lowest item was “painful cold” (0.226).
The results are higher than those obtained using Portuguese (80.17% when used in spinal cord injury patients. In patients with back surgery syndromes [29], but lower than the Spanish (97.1%), respectively. The results are higher than those of the gery syndromes [29]. In the original version of the DN4 [18], the sensitivity and specificity were 82.9% and 89.9%, respectively; in the Dutch version of the DN4, the sensitivity and specificity were relatively low, with values of 75% and 79%, respectively [20]. In the Spanish version of the DN4, the sensitivity and specificity were as low as 79.8% and 78%, respectively [32]. Meanwhile, the sensitivity of the DN4 is lower than those in Greek [21] and Persian [25] versions, as well as in patients with spinal cord injury [27]; however, the specificity is higher than that in previous studies. Spallone et al. [33] showed that the DN4 displayed sensitivity of 80% and specificity of 92% in painful diabetic polyneuropathy. Extending to diverse population, we chose patients with non-neuropathic pain for comparison. The apparent diversity may be due to the clinical characteristics of the patients, such as inclusion of individuals with mixed pain, as well as pain classification and differences in clinical diagnosis.

In patients with PDPN, complaints, including tingling, pins and needles, and sensations like electric shocks, were assessed by the LANSS and DN4; these findings are consistent with the clinical signs and symptoms based on the definition of neuropathic pain. Although the DN4 and LANSS were developed as a screening tool for detecting neuropathic pain, these instruments are not considered as diagnostic tools and cannot be employed for medical diagnosis.

On average, patients’ pain was not well-controlled, with mean pain scores of 5 or higher. PDPN seriously affected the life of the patients. Hence, pain control needs to be improved. In 2011, the American Academy of Neurology released the evidence-based guideline “Treatment of painful diabetic neuropathy;” this guideline recommends the use of tricyclic antidepressants and anticonvulsants for painful diabetic neuropathy [34]. A Chinese translation of the clinical guidelines on how to use these drugs treating painful diabetic neuropathy patients is also available; however, implementation of the guideline in clinical practice was not reliable and may influence the effectiveness of treatments for PDPN and patient outcome.

Previous studies reported that neuropathic pain of patients could lead to inability to walk, reduced productivity, and reluctance to participate in social activities [35]. Particularly, the inability to walk of some patients could result in social dysfunction. Neuropathic pain assessment tools, such as the LANSS, DN4, and BPI-DPN, could be used by healthcare professionals to elucidate the extent of pain severity and its interference on patients with PDPN. These tools can also be used to develop appropriate interventions for alleviating the symptoms and improving the quality of life of patients.

This study presents several limitations that should be considered in interpreting the results. First, patients with mixed pain were excluded, which may influence the results because these patients are probably the most difficult group to diagnose with or without neuropathic pain. In addition, these patients could have a neuropathic component that contributes to their pain. Second, the same person performed data collection without blinding, and all tools were completed at one time. This factor may also affect the results.

5. Conclusions

The LANSS, DN4, and BPI-DPN could be used to diagnose Chinese patients with PDPN. Comparison shows that the DN4 exhibits higher diagnostic sensitivity than the LANSS. The
LANSS or the DN4 could be used to detect neuropathic pain in patients with PDPN. The BPI-DPN could also be used to monitor the effectiveness of pain intervention.

Author contributions

Li and Chen conceived the study. Li provided statistical advice on study design. Chen collected and analyzed the data. Chen drafted the manuscript, and all authors contributed substantially to its revision.

Conflicts of interest

None declared.

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REFERENCES


