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REVIEW ARTICLE

Low back pain: critical assessment of various scales

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Abstract

Purpose To study the various pain assessment tools based on their psychometric properties and ease of use.

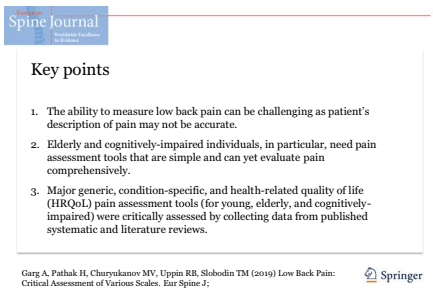
Methods Published articles on psychometric properties of pain tools were accessed and data collected for low back pain (LBP)-specific tools, generic tools, neuropathic LBP tools, tools for cognitively impaired patients, and tools for acute LBP.

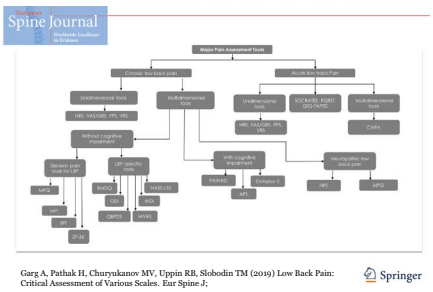
Results Among the LBP-specific tools, Roland Morris Disability Questionnaire (RMDQ) and Oswestry Disability Index (ODI) have good construct validity and reliability, and responsiveness over short intervals. Quebec Back Pain Disability Scale (QBPDS) gauges only disability and sleep. Among the generic tools, McGill Pain Questionnaire (MPQ), West Haven-Yale Multidimensional Pain Inventory (MPI), and Brief Pain Inventory (BPI) show good responsiveness, but BPI is the only tool validated for LBP. Neuropathic Pain Scale (NPS) and Short Form-MPQ-2 (SF-MPQ-2) are both reliable tools for neuropathic LBP. For cognitively impaired patients, Pain Assessment in Advanced Dementia (PAINAD), Abbey Pain Scale (APS), and Doloplus-2 are all reliable tools, but PAINAD has good construct validity. For acute pain, Clinically Aligned Pain Assessment (CAPA) is reliable and responsive, but presently, unidimensional tools and SF-MPQ-2 are the tools most preferred.

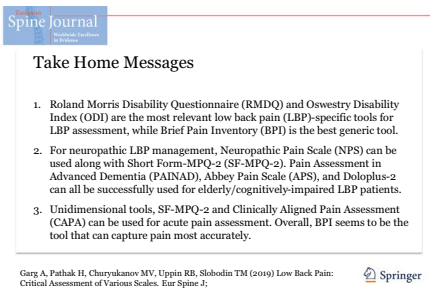
Conclusion Based on psychometric properties and ease of use, the best tools for LBP seem to be RMDQ/ODI (among LBP-specific tools), BPI (among generic tools), SF-MPQ-2/NPS (for neuropathic LBP), PAINAD (for cognitively impaired patients), and unidimensional tools and SF-MPQ-2 (for acute pain). Overall, BPI seems to be a tool that can be relied upon the most.

Graphic abstract

These slides can be retrieved under Electronic Supplementary Material.







Keywords Low back pain tools · Psychometric properties · RMDQ · ODI · BPI

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Abbreviations

APS	Abbey Pain Scale
BPI	Brief Pain Inventory
CAPA	Clinically Aligned Pain Assessment
Doloplus	After the French investigator who developed the tool
FPS	Faces Pain Scale
MPI	West Haven-Yale Multidimensional Pain Inventory
MPQ	McGill Pain Questionnaire
MVAS	Million's Visual Analogue Scale
NASS-LSO	The North American Spine Society Lumbar Spine Outcome
NPS	Neuropathic Pain Scale
ODI	Oswestry Disability Index
NRS	Numerical Rating Scale
PAINAD	Pain Assessment in Advanced Dementia
QBPDS	Quebec Back Pain Disability Scale
RMDQ	Roland Morris Disability Questionnaire
SF-36	Short Form-36
VAS/GRS	Visual Analogue Scale/Graphic Rating Scale
VRS	Verbal Rating Scale
WDI	Waddell Disability Index

Introduction

Pain afflicts humans not only in sickness, critical illness, or palliative care but also in their everyday life. According to International Classification of Functioning, Disability and Health, low back pain (LBP) alters basic body functions such as sleep and motility, and causes changes in a person's spinal and musculoskeletal structures [1]. Acute and chronic LBP can be caused by a variety of medical conditions including trauma, muscle strain, lumbar spondylosis, spinal stenosis, spine and kidney infections, certain cancers, endometriosis, arthritis, and ankylosing spondylitis. More than 80% of the population experiences LBP at some point in their lives [2]. Many go on to recover naturally or with the help of some form of intervention, while others develop chronic back pain with pain lasting more than 3 months. The number of years lived with disability triggered by LBP has increased by 54% between 1990 and 2015, worldwide [3]. LBP is one of the major reasons of low performance at work, missed work, disability requests after an episode of acute pain or post-operative condition, and is known to cause more global disability than any other condition [4–6].

The major domains assessed for chronic pain are pain severity, pain-related functional interference, and emotional burden [7], while for acute pain it is mainly pain severity and relief thereof [8]. Pain assessment tools can be used for general pain (generic tools), for condition-specific pain, or for health-related quality of life (HRQoL) [9]. Many general tools are used independently in disease conditions or used in combination with some condition-specific tool. A condition-specific tool is also used in conjunction with some HRQoL tool for complete pain assessment. Tools can be self-reported or observational depending upon the patient's consciousness or cognizance. In this article, we aim to discuss some major generic, condition-specific, and HRQoL tools that are used regularly and extensively by physicians and patients worldwide for LBP.

Search strategy

For this review, we first set a few primary questions:

1. What are the tools/scales available for the assessment of chronic and acute pain?
2. What tools are majorly used for chronic and acute LBP?
3. How are these tools relevant for various patient populations like people with and without cognitive impairment, and neuropathic LBP?

Search terms were entered as Medical Subject Headings (MeSH) terms or free text on PubMed and Scopus. Following terms were used to search literature: "pain assessment scales", "chronic back pain", "low back pain assessment", "psychometric properties", "patient-reported outcome measures", "PROM", "dementia", "neuropathic pain", "pain in elderly". Original research articles and reviews (systematic and narrative) from January 1980 to February 2019 were accessed. Articles without a comprehensive study of pain assessment tools were excluded. Articles on pain assessment tools, specifically for psychometric properties, were searched to understand what the major patient-reported outcome measures (PROM) were. Comprehensive studies and reviews on the validity, reliability, stability, and responsiveness of each PROM were selected. We found that certain generic tools [Brief Pain Inventory (BPI), McGill Pain Questionnaire (MPQ), West Haven-Yale Multidimensional Pain Inventory (MPI), and Short Form-36 (SF-36)] are extensively used to assess LBP, and thus, we extended our search to include these tools along with LBP-specific tools. These generic tools are used to measure pain in general that may not be localized to a specific region of the body. A list was drawn for the number of articles obtained for nine major tools suggested [9, 10]. Among these, there were numerous results (> 100) for three tools [Roland Morris Disability Questionnaire (RMDQ), Oswestry Disability Index (ODI),

Table 1 Selection of low back pain-specific tools

S. no.	Name of low back pain-specific tool	Review articles + systematic reviews + RCTs	Foreign language + irrelevant topics (not LBP + does not involve the pain tool)	Relevant articles
1.	ALBPS	28	11	17
2.	LBOS	9	3	6
3.	LBPRS	9	4	5
4.	MVAS	78	46	32
5.	NASS	49	3	46
6.	ODI	3678	NA	3678
7.	QBPDS	159	NA	159
8.	RMDQ	976	NA	976
9.	WDI	36	10	26

ALBPS Aberdeen LBP Scale, *LBOS* Low Back pain Outcome Score, *LBPRS* Low Back Pain Rating Scale, *MVAS* Million's Visual Analogue Scale, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *ODI* Oswestry Disability Index, *QBPDS* Quebec Back Pain Disability Scale, *RMDQ* Roland Morris Disability Questionnaire, *WDI* Waddell Disability Index

Table 2 Pain assessment tools based on various outcome domains and patient groups

S. no.	Outcome domains	Name of tools
1.	Pain intensity, quality, location, and pattern (general and condition-specific)	MPQ, RPS
2.	Pain interference and functioning (general)	PDI, BPI, FIM, DDS
3.	Pain interference and functioning (disease-specific)	WOMAC, RMDQ, ODI, QBPDS, NASS-LSO, MVAS, WDI, MPI, SF-36, SIP, NPS, PAINAD, APS, Dolo-plus-2
4.	Psychosocial measurements	BDI, PCS, CSQ
5.	Observational pain assessment instruments (general and critically ill patients). Mostly for non-verbal pain assessment when patient may not be alert, conscious or in a state to talk	CPOT, ESAS, PCOS

APS Abbey Pain Scale, *BDI* Beck Depression Inventory, *BPI* Brief Pain Inventory, *CSQ* Coping Strategies Questionnaire, *CPOT* Critical Care Pain Observation Tool, *DDS* Descriptor Differential Scale, *Doloplus-2* After the tool's developer, *ESAS* Edmonton Symptom Assessment Scale, *FIM* Functional Independence Measure, *MPQ* McGill Pain Questionnaire, *MVAS* Million Visual Analogue Scale, *NPS* Neuropathic Pain Scale, *ODI* Oswestry Disability Index, *PAINAD* Pain Assessment in Advanced Dementia Scale, *PCS* Pain Catastrophizing Scale, *PDI* Pain Disability Index, *PCOS* Palliative Care Outcome Scale, *QBPDS* Quebec Back Pain Disability Scale, *RPS* Regional Pain Scale, *RMDQ* Roland Morris Disability Questionnaire, *SF-36* Short-Form survey, *SIP* Sickness Impact Profile, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *WDI* Waddell Disability Index, *MPI* West Haven-Yale Multidimensional Pain Inventory, *WOMAC* Western Ontario McMaster Osteoarthritis Index

Quebec Back Pain Disability Scale (QBPDS)], and their popularity evident, we did not go through all the results to check for data relevance. Three other tools [Aberdeen LBP Scale (ALBPS), Low Back pain Outcome Score (LBOS), and Low Back Pain Rating Scale (LBPRS)] were excluded from this review due to lack of substantial results, bringing it to a total of six LBP-specific tools [RMDQ, ODI, QBPDS, Million Visual Analogue Scale (MVAS), Waddell Disability Index (WDI), and the North American Spine Society Lumbar Spine Outcome (NASS-LSO)] (Table 1).

Tools/scales for measurement of chronic and acute pain

In 2002, Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) was developed by a team of pain experts from various industries and academia in the USA as an improved method of pain assessment during clinical trials [11]. They highlighted the importance of six core outcome domains to assess chronic pain: pain, physical functioning, emotional functioning, patient's rating of overall improvement after treatment, patient-reported adverse effects during treatment, and patient's disposition and characteristics data. In the same year, more outcome domains pertaining to HRQoL were also added to IMMPACT [12]. There are various pain assessment tools

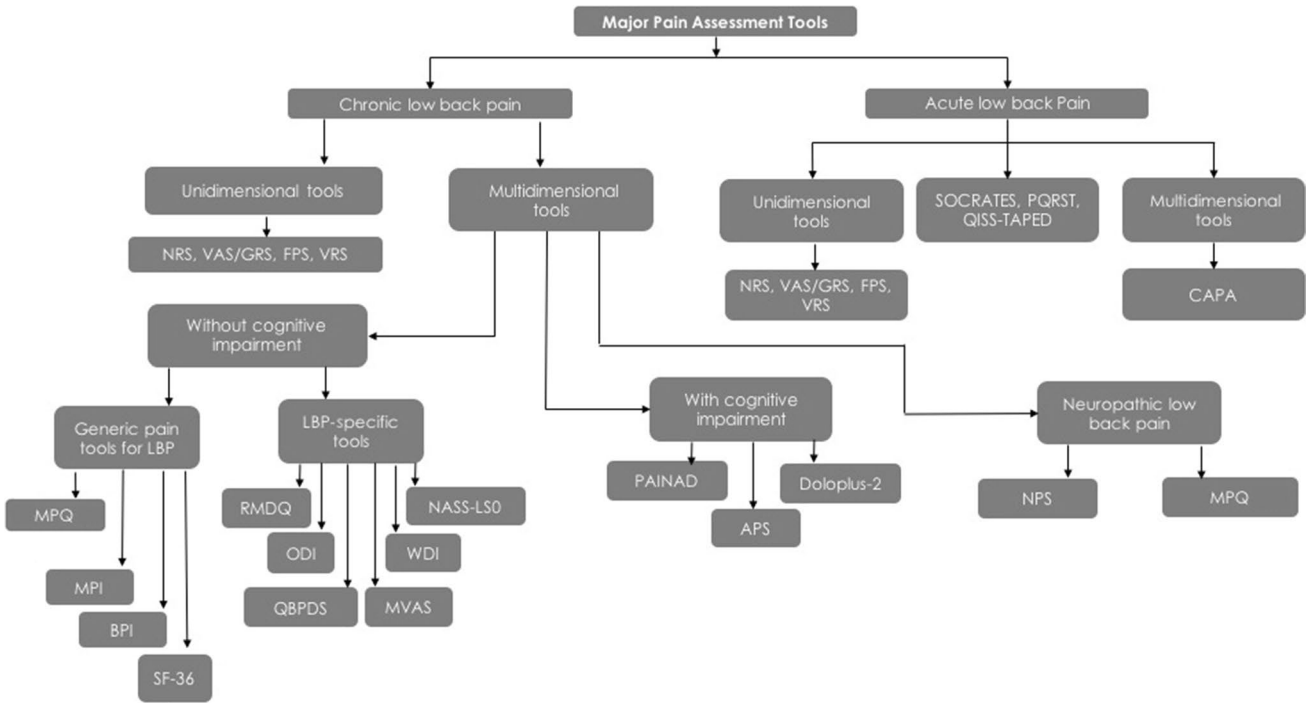

Fig. 1 Majorly used pain assessment tools. *APS* Abbey Pain Scale, *BPI* Brief Pain Inventory, *CAPA* Clinically Aligned Pain Assessment, *Doloplus* After the French investigator who developed the tool, *FPS* Faces Pain Scale, *MPI* West Haven-Yale Multidimensional Pain Inventory, *MPQ* McGill Pain Questionnaire, *MVAS* Million's Visual Analogue Scale, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *NPS* Neuropathic Pain Scale, *ODI* Oswestry Disability Index, *NRS* Numerical Rating Scale, *PAINAD* Pain Assessment in Advanced Dementia, *QBPDS* Quebec Back Pain Disability Scale, *RMDQ* Roland Morris Disability Questionnaire, *SF-36* Short Form-36, *VAS/GRS* Visual Analogue Scale/Graphic Rating Scale, *VRS* Verbal Rating Scale, *WDI* Waddell Disability Index

Table 3 Unidimensional pain assessment tools

S. no.	Name of tool	Description
1.	NRS	A 0–10/0–20/0–100 scale of pain intensity, where zero and maximum value stand for no pain and highly intense pain, respectively
2.	VAS/GRS	Patients select their level of pain on a 10 cm scale; sometimes with descriptive terms
3.	VRS	4–5-point scale with words like "no pain", "moderate pain", "severe pain", etc. SF-36 is a good example
4.	FPS	Mostly for children and elderly, choices range between a happy face to a face showing extreme pain

FPS Faces Pain Scale, *NRS* Numerical Rating Scale, *SF-36* Short Form-36, *VAS/GRS* Visual Analogue Scale/Graphic Rating Scale, *VRS* Verbal Rating Scale

associated with different outcome domains and patient groups (Table 2) (Fig. 1).

Chronic low back pain tools

For the assessment of chronic LBP, both unidimensional and multidimensional tools are used.

Unidimensional tools These tools only measure the intensity of pain and are explained briefly in Table 3.

Multidimensional tools These tools measure not only the severity of pain but also integrate other dimensions such as pain-based interference on HRQoL and functioning, location of pain, and emotional burden. The majorly used multidimensional tools for adults (young and elderly) with and without cognitive impairment, and for adults with neuropathic low back pain are explained in Tables 4 and 5. The merits and demerits of these tools are listed in Table 6.

Acute low back pain tools

Acute pain measurement and management is usually straightforward and relies on documenting two outcome domains, namely pain intensity and relief post-treatment.– They usually involve unidimensional tools such

Table 4 Multidimensional tools for adults with and without cognitive impairment, and for adults with neuropathic low back pain

Multidimensional tools for adults (young and elderly) without cognitive impairment			
Generic tools		LBP-specific tools	
BPI [13]	15-item tool 2 domains: pain intensity, pain interference Short-form BPI for both chronic and acute pain LBP Valid and reliable in accurately assessing pain	RMDQ-24 [14]	24 questions 2 Psychosocial 3 Sleep/rest 15 Physical functioning 1 Eating 2 Home management 1 back pain frequency 5 min to complete Questions pertain to pain experienced during various activities in and around the house Most questions include the phrase "because of my back" Questions: RMDQ-23/RMDQ-18: derived versions
MPQ [15]	New 22-item version by Dworkin et al. [16] that includes neuropathic pain Useful for both chronic and acute pain SF-MPQ-2: 15 items derived version	ODI [17]	10 items 5 min to complete Includes questions on pain intensity, sex life, social life, and travelling
MPI [18]	52 items, 12 scales 3 parts: Pain severity, pain interference, Responses Household, social activities	QBPDS [19]	20 items 6 major groups 5–10 min to complete No questions on social life, sex life, and pain intensity
SF-36 [20]	36 items 2 health constructs: PCS, MCS 5–10 min to complete	MVAS [21]	15 questions 3 major domains Body functions Daily activities Social life 5 min to complete Uses VAS
		WDI [22]	9 items 5 min to complete Items on back-involved activities and social life
		NASS-LSO [23]	62 items 5 categories Demographic data Medical history Body functions Employment history Treatment outcomes 20 min to complete Pain locating picture to mark the regions of pain
Multidimensional tools for cognitively impaired adults with low back pain			
PAINAD [24]	5 items: facial expression, breathing, negative vocalizations, consolability, body language Range: 0–10 Only few minutes to complete Endorsed by American Medical Directors Association Derived from items of FLACC, DS-DAT, and pain experiences of patients and clinical staff		
APS [25]	6 items: facial expression, vocalization, physiological change, physical change, change in body language, behavioural change Range: 0–3 Less than a minute to complete Recommended by British Geriatrics Society and the Australian Pain Society		
Doloplus-2 [26]	10 items 5 somatic, 2 psychomotor, 3 psychosocial items 6–12 min to complete Overall score of 0–30		

Table 4 (continued)

Multidimensional tools for adults with neuropathic low back pain	
NPS [27]	10 items 8 items for pain localization and quality, 2 global items for pain severity and unpleasantness

APS Abbey Pain Scale, *BPI* Brief Pain Inventory, *Doloplus* After the French investigator who developed the tool, *FLACC* Face, Legs, Activity, Cry, Consolability Scale, *MPI* West Haven-Yale Multidimensional Pain Inventory, *MPQ* McGill Pain Questionnaire, *MVAS* Million's Visual Analogue Scale, *MCS* Mental Component Summary, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *NPS* Neuropathic Pain Scale, *ODI* Oswestry Disability Index, *PCS* Physical Component Summary, *PAINAD* Pain Assessment in Advanced Dementia, *QBPDS* Quebec Back Pain Disability Scale, *RMDQ* Roland Morris Disability Questionnaire, *SF-36* Short Form-36, *SF-MPQ-2* Short Form-MPQ-2, *WDI* Waddell Disability Index

as Numerical Rating Scale (NRS), Visual Analogue Scale (VAS), Verbal Rating Scale (VRS), and Faces Pain Scale (FPS), but multidimensional tools like BPI and SF-MPQ-2 are also used to assess pain. Acute pain, like chronic pain, should be assessed at both rest and movement, but movement-evoked pain assessment is more crucial for acute pain as this variety of pain is also a part of post-operative recuperative pain. There are certain unvalidated mnemonic tools as well, and even though they are unvalidated, they are very useful in measuring acute pain [8] (Table 7). Apart from these unvalidated tools, there is a new tool called Clinically Aligned Pain Assessment (CAPA) that is being used successfully for acute pain management. In 2013, Donaldson and Chapman [8, 64] developed this tool for University of Utah Health Care to replace the unidimensional NRS. This tool is now being used primarily in the University of Utah Hospital. A total of five domains, namely comfort, change in pain, pain control, functioning, and sleep are assessed. There is no script to follow or boxes to check, and patients and physicians engage in a conversation that is later evaluated in a coded manner. In a quality improvement study with more than 12,000 pain assessment observations, patients opted for CAPA much more than NRS [8]. Topham and Drew came up with its modified version in 2015 [64]. They used both process and outcome measures to understand staff compliance and patient satisfaction, respectively. This measure proved to be successful in increasing patient and staff satisfaction for both the independent research groups [8, 64]. Reliability and validity of the tool are not tested as it lacks scoring rules.

Comparing the different tools for assessment of low back pain

The biggest challenge faced by physicians and nursing staff is the ability to capture the severity of chronic pain as most often they have to rely on the patient's memory or description of pain that may not be accurate. When daily diaries of pain are to be maintained by the patient, they are usually filled up in a hurry just prior to the visit to the doctor. Other limitations to capturing pain accurately are factors such as lack of education, disability, language barriers, incomprehension due to dementia, or simply, the lack of consciousness. Some pain scales can be complex and require training to use, while others can be long, making most respondents not answer all items in the questionnaire [26, 54]. Elderly and cognitively impaired individuals require pain scales that are simple, yet comprehensive [56, 57]. Thus arose the need to formulate specific scales that are simple, quick, and can be used to not only acquire the patient's input but also deliver quality pain management, providing eventual satisfaction and relief to both the patient and physician. Over the years, many tools have been developed for the assessment and management of LBP. Evaluating the quality of a tool to understand its psychometric properties is very important in helping the physician choose the best possible instrument to use [43]. In this review, we tried to maintain a level of consistency in reviewing all the psychometric properties of a tool, but there was a gap in information/research on certain parameters.

For the assessment of LBP, functional/disability measures, pain severity measures, and the measures for the effect of pain on social life and general mental health are used [9]. Functional measures can be both generic and condition-specific. Generic measures estimate symptoms related to various regions of the body and need not be spine-centric, while condition-specific measures assess symptoms specific to a disease or condition, for example, LBP. Both generic and condition-specific measures are used by physicians and patients as functional measures for LBP management [65, 66]. All LBP-specific measures that we covered in this article have been successfully used cross-culturally.

RMDQ and ODI have good content, construct validity, test–retest reliability, and responsiveness but are good at detecting changes over short intervals only [43]. While ODI can be used as both a functional measure and for pain severity, RMDQ lacks there in being only a good functional measure. Evaluation of psychological domains cannot be done with RMDQ as certain questions pertaining to the areas are lacking. It works well on patients with moderate

Table 5 Psychometric properties of low back pain tools (generic and condition-specific)[a–e]

Pain assessment tool	Reliability	Validity	Responsiveness	Floor-ceiling effects
Generic tools for back pain				
BPI	High test–retest reliability value of 0.97 [28] Internal consistency for pain severity and interference: 0.89, 0.95 for arthritis, 0.82, 0.93 for low back pain [29]	High correlations with body pain scale of SF-36 (0.61–0.64), and RMDQ (0.57–0.81) [29]	Excellent sensitivity; SRM values for pain severity and interference − 1.09 and − 1.13, respectively [29]	Ceiling effect [30]: Subscale 'pain 24-h worst'—18.5% Other subscales—1.4–3.5%
MPQ	Test–retest reliability values mostly above 0.9 [16, 31] Test–retest values of 0.62–0.75 (musculoskeletal pain) and 0.79–0.95 (rheumatic pain) [32] Internal consistency at 0.88–0.91 [31]	Poor to fair correlations of 0.21–0.42 with short-form BPI and NRS [30]	Sensitivity of the tool at 1–3 day interval is comparable with that of VAS ROC moderate at 0.61; SRM large at > 0.8 suggesting good sensitivity to change [32]	Floor effect: 12.5% and 15.1% for neuropathic and affective subscales, respectively [30]
MPI	Fair to excellent test–retest reliability (0.62–0.91; 0.46–0.93; 0.62–0.89), [18, 33, 34] Significant internal consistency values of 0.60–0.92 (cancer) [35], 0.63–0.93 (chronic back pain) [33]	Excellent content validity suggesting all items within the tool measure the same construct [35] Pain interference of MPI (0.76) relates well with BDI (0.51) [18]	Fair to moderate SRM between − 0.10 to 0.72 (various subscales) [34]	No floor or ceiling effects reported
HRQoL tool				
SF-36	Good test–retest reliability values > 0.8 for PF, PR and BP, fair values for MH (0.55) [36] Good internal consistency ≥ 0.78 for all scores [37]	Good validity as all items are about health or pain but wide floor-ceiling effects of many items for rheumatic patients may be a sign that all health concerns are not fully captured [36] Correlation values of − 0.295 to − 0.66 for PF, BP and MH for RMDQ [38]; − 0.428 to − 0.70 for PF, BP, SF and MH for ODI [38]; − 0.25 to − 0.64 for PF, BP and MH for QBPDS [39]	SRM scores 0.44–0.67 [40]	Large floor-ceiling effects observed with rheumatic patients [36]
Low back pain-specific tools				
RMDQ-24	Test–retest reliability values 0.91 for same day [14], 0.86 for 3–6 weeks [41] Excellent internal consistency of 0.86 for 7 days [42]	Limited range of questions pertaining to physical functions; designed to address general problems faced by people suffering from back pain; only one question applies to the emotional state of the person [43] No certain content validity [44]; fair correlation of 0.5 [45] to ODI, and 0.6 to QBPDS [45]	Relevant for patients with little disability [43] Retest interval ROC values at 6 weeks (0.77) [40], 8 weeks (0.64) [46]	Floor effects present but no ceiling effects [47]
ODI	Test–retest reliability value for 1 day (0.94–0.99) [48, 49] Inter-rater reliability high (0.94) [49] Internal consistency values at 0.835–0.90 [49]	Uncertain content validity [44]. Correlation with RMDQ of 0.5 correlation coefficient [45]	High sensitivity with ROC values > 0.7 [40, 46]	Floor effects present but no ceiling effects [47]

Table 5 (continued)

Pain assessment tool	Reliability	Validity	Responsiveness	Floor-ceiling effects
QBPDS	Test–retest reliability values of 0.84 at 6 weeks, and 0.93 at 1–14 days [19, 39] Internal consistency > 0.9 [19]	Good content with all questions pertaining to various activities; agrees with both physicians and patients No questions on sexual activities Strong correlation with RMDQ (0.77), ODI (0.80), physical function subscale of SF-36 (0.72) [19]	Extremely sensitive tool with ROC values at 0.74 and above 0.80 [40]	No floor or ceiling effects [40]
MVAS	Test–retest reliability values 0.735–0.844 (daily activities), 0.581–0.745 (body functions), 0.736–0.849 (social life) [50] Internal consistency acceptable for daily activities and social life (0.794, 0.799) but unacceptable for body functions (0.67) [50]	Excellent goodness of fit results with confirmatory factor analysis; suggests all questions of the tool are essential and contribute to measuring what the tool sets out to assess [50]	Significant decrease in mean pain at three-month and one-year interval (17.1, 15.9) [51] Predicted treatment outcomes in patients with chronically disabling spine disorder [52]	Floor and ceiling effects below 15% [50]
WDI	Moderate test–retest reliability (ICC = 0.74) for "unchanged group" [40] Per cent inter-rater reliability 73–90% for each question of the tool [22]	Factor analysis confirmed the tool's questions to be consistent, inter-connected and to provide a good measure of disability [22] Correlates well with another disability tool, ODI, with correlation coefficient of $r = 0.7$ [22]	Able to detect significant changes after one-month interval in patients [53]	No reported floor-ceiling effects
NASS-LSO	High test–retest reliability for 24 h (0.85–0.97) [23] High internal consistency (0.71–0.93) [23] Test–retest reliability 0.82 (pain/disability), 0.95 (neurogenic symptoms) and 0.63 (expectations) [54]	Pain/disability functions correlate well with SF-36 PCS (−0.82) and VAS (0.46–0.63) at baseline [54] Correlation with the MCS of SF-36 only fair with a value of 0.5 [54]	Large effect size (2.02) for combined pain/disability and neuro symptoms [54]	No reported floor-ceiling effects
Tools for cognitively impaired				
PAINAD	Good inter-rater reliability of 0.82–0.97 during pleasant and unpleasant activities [24], 0.31 at rest and 0.54 during movement [55] Internal consistency 0.50–0.6 [24]	Good construct; can discriminate between pain associated with different conditions, like pleasant and unpleasant activities High concurrent validity values of 0.89–0.95 (pleasant activity) and 0.82–0.91 (unpleasant activity) with pain scale of VAS [24] Good correlations (0.76) with DS-DAT and discomfort scale of VAS [24]	No reported measure of responsiveness	No reported floor-ceiling effects

Table 5 (continued)

Pain assessment tool	Reliability	Validity	Responsiveness	Floor-ceiling effects
APS	Inter-rater reliability values of 0.83 and 0.88 at rest and exercise, respectively [56]; internal consistency of 0.65–0.736 [57] Removing the item "physical change" improved the fit of the tool and increased internal consistency to 0.77 from 0.75 [56]	Correlation coefficient of APS with PAINAD 0.75–0.82 (at rest), 0.83–0.89 (during exercise), and 0.69–0.83 (at rest), 0.68–0.79 (during exercise) with DS-DAT [56]; indicates that all three tools measure similar domains	Pain reduction in 88% patients post-treatment with analgesics at $p < 0.001$ [58]	No reported floor-ceiling effects
Doloplus-2	Good inter-rater reliability of 0.73–0.81 [57] Test–retest reliability of 0.96 [26] High internal consistency of 0.85–0.86 at different time points [57]	Poor correlations with PAINAD, VAS and VRS with values ranging from 0.29–0.36 [26]	Significant reduction in mean scores after a given interval ($R^2 = 0.216$) [59]	No reported floor-ceiling effects
Neuropathic pain-specific tool				
NPS	Test intervals (about 33 days) produced test–retest reliability values of ICC = 0.71 as a total score, and individual ICC varied between 0.45–0.78 [60] Good internal consistency of 0.78 [60]	Excellent content validity with patients choosing to answer about 8 of the 10 items involved in this tool [60]; suggests that most articles in this tool are relevant to neuropathic pain One item allows patients to describe their pain in their own words	No reported responsiveness	No reported floor-ceiling effects

APS Abbey Pain Scale, *BPI* Brief Pain Inventory, *Doloplus* After the French investigator who developed the tool, *MPI* West Haven-Yale Multidimensional Pain Inventory, *MPQ* McGill Pain Questionnaire, *MVAS* Million's Visual Analogue Scale, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *NPS* Neuropathic Pain Scale, *ODI* Oswestry Disability Index, *PAINAD* Pain Assessment in Advanced Dementia, *PF* physical functioning, *PR* Physical role limitations, *BP* Bodily pain, *MH* Mental Health, *QBPDS* Quebec Back Pain Disability Scale, *RMDQ* Roland Morris Disability Questionnaire, *SF-36* Short Form-36, *SRM* Standardized Response Mean, *WDI* Waddell Disability Index

[a]Reliability measurement: 1. Inter-rater reliability: All values Pearson's coefficient, intraclass coefficient (ICC) or Kappa coefficient. 2. Test–retest reliability: Values given as ICC or Pearson's coefficient. 3. Internal consistency: Values given as Cronbach's alpha (α)

[b]Concurrent validity measurement: By comparison with other validated tools. All values Pearson's correlation coefficient

[c]Responsiveness measurement: Values given as effect size (ES; expressed as Pearson's *r* or Cohen's *d*), standardized response mean (SRM), or Receiver Operating Characteristic (ROC) curve. Area under this curve of 0.5 is poor and a value of 1.0 is perfect

[d]Floor-ceiling effects: Values < 15% acceptable

[e]The statistical results show poor, adequate, good, and excellent values at < 0.5, 0.5–0.7, 0.7–0.8, > 0.9, respectively. The minimum acceptable limit for Cronbach's α is 0.7, and a score > 0.9 indicates redundancy

Table 6 Merits and demerits of some major low back pain tools (generic and condition-specific)

Name of tool	Type of pain	Merits	Limitations	References
Generic tools for back pain				
BPI	Chronic/acute	Easy to score Can represent pain graphically Test–retest reliability high over short intervals High correlations with SF-36 and RMDQ Excellent responsiveness Cross-cultural use	Time-consuming	[28–30]
MPQ	Chronic/acute	Not unidimensional Allows collection of both qualitative and quantitative data Includes nociceptive and neuropathic items of sensory pain dimension Has good construct, content, and criterion validity Sensitive to intervention Strong reliability for cancer patients Psychometrically sound Cross-cultural use	Time-consuming Difficult to interpret Only three pain patterns not adequate for cancer patients	[16, 30, 31]
MPI	Chronic	Easy to administer Test–retest reliability across various domains ranges from adequate to excellent (depending upon language and disease) Construct validity adequate to excellent for chronic pain Psychometrically sound Cross-cultural use	Internal consistency scores disputed; ranges from adequate to excellent, or poor for certain domains like life control	[18, 33–35]
HRQoL tool				
SF-36	Chronic/acute	An HRQoL tool with an equally reliable and valid derivation, SF-12 Good to excellent reliability for PCS, excellent internal consistency for all domains Satisfactory correlations of physical functioning and pain with other disability tools Cross-cultural use	Poor reliability for mental health and social functioning Poor correlations of mental health with other disability tools Disputed responsiveness	[36–40, 61]
Low back pain-specific tools				
RMDQ-24	Chronic	Simple to use and fast completion Shows high correlation for physical function with other tools like ODI, SF-36, QBPDS Has good construct and concurrent criterion validity, internal consistency Test–retest reliability high over short intervals Cross-cultural use	Focusses on limited range of physical functions common only to patients with LBP; no option of "not applicable" on scoring system Poor test–retest reliability over long intervals Dichotomous response categories make it difficult to get much information Responsiveness depends on severity of disability Not very psychometrically sound	[41–43, 45]

Table 6 (continued)

Name of tool	Type of pain	Merits	Limitations	References
ODI	Chronic	Simple to use; fast completion and scoring Telephonic interview possible Shows good correlation with other tools like MPQ, VAS, SF-36 Has good construct validity, internal consistency Test–retest reliability high over short intervals Responsiveness acceptable for population of not severely affected people Good predictor of return-to-work Cross-cultural use	Poor test–retest reliability over long intervals Not so sound psychometrically	[39, 62, 63]
QBPDS	Chronic	Easy to administer and to score Possible in telephonic/mail interviews High test–retest reliability, good content and construct validity Has strong correlations with other disability tools Low item omission for activities asked to be performed Cross-cultural use	Has also been reported by some to be adequate to poor in terms of physical function and psychosocial measure Items on sex and social life not included	[19, 39, 40, 45]
MVAS	Chronic	Easy to administer and score; fast completion Mostly good test–retest reliability and internal consistency for daily activities and social life Has good construct validity and responsiveness Strong unidimensional measure of pain severity Cross-cultural use	Test–retest over various long and short intervals not tested Poor internal consistency for body functions Little psychometric evidence available	[50–52]
WDI	Chronic	Extremely simple and fast tool; easy to score Moderate test–retest reliability Good inter-rater reliability, construct validity Data can be pooled; advantage for clinical trials Cross-cultural use	Limited data on responsiveness	[9, 22, 40]
NASS-LSO	Chronic	High test–retest reliability over short intervals High internal consistency and construct validity Extensive low back pain-dominant questions Cross-cultural use	Extremely complex to administer and score Time-consuming No single questionnaire used; questions may be repeated Limited psychometric data	[23, 54]
Tools for cognitively impaired				
PAINAD	Chronic	Good construct validity and inter-rater and test–retest reliability Easy to administer and requires no intensive training as compared to other tools for patients with dementia Preferred tool of physicians Cross-cultural use	Not all actions presented by dementia patients may be caused by pain, for example, a sudden outburst may be due to emotional turmoil Internal consistency not acceptable, but can be improved by deleting "breathing" and "negative vocalization" Limited psychometric data	[24, 55]
APS	Chronic	Good internal consistency Good to excellent inter-rater reliability High correlations with PAINAD and DS-DAT Extremely good construct Takes less than a minute to complete Cross-cultural use	Construct of the tool not so sound; can be improved with removal of the item "physical change" Limited psychometric data	[56–58]

Table 6 (continued)

Name of tool	Type of pain	Merits	Limitations	References
Doloplus-2	Chronic	Simple to use Good inter-rater reliability and high internal consistency Excellent sensitivity to change Cross-cultural use	Takes 6–12 min to complete Construct validity only adequate Poor correlations with PAINAD, VAS and VRS Internal consistency and test–retest reliability controversial Requires extensive training	[26, 57, 59]
Tool for neuropathic pain				
NPS	Chronic	Good reliability and internal consistency Excellent content validity with high relevance to neuropathic pain Cross-cultural use	No data on responsiveness Limited psychometric data	[27, 60]
Tool specifically for acute pain				
CAPA	Acute	The only tool specific for acute pain Good patient and staff satisfaction	Psychometric data limited	[8, 64]

APS Abbey Pain Scale, *BPI* Brief Pain Inventory, *CAPA* Clinically Aligned Pain Assessment, *Doloplus* After the French investigator who developed the tool, *FPS* Faces Pain Scale, *MPI* West Haven-Yale Multidimensional Pain Inventory, *MPQ* McGill Pain Questionnaire, *MVAS* Million's Visual Analogue Scale, *NASS-LSO* The North American Spine Society Lumbar Spine Outcome, *NRS* Numerical Rating Scale, *ODI* Oswestry Disability Index, *PAINAD* Pain Assessment in Advanced Dementia, *NPS* Neuropathic Pain Scale, *QBPDS* Quebec Back Pain Disability Scale, *RMDQ* Roland Morris Disability Questionnaire, *SF-36* Short Form-36, *WDI* Waddell Disability Index, *VAS/GRS* Visual Analogue Scale/Graphic Rating Scale, *VRS* Verbal Rating Scale

disability, while ODI works well on people with severe disability of a persistent type [43]. ODI also has questions on a patient's sexual and social life providing a multifaceted pain assessment. QBPDS too is a functional tool like RMDQ and gauges only disability and sleep without measuring pain intensity [9]. It should be used in association with a pain-measuring unidimensional tool like NRS or VAS/GRS. WDI is a simple and short tool with an internal consistency higher than that of RMDQ but lower than ODI [40]. It has also been shown to detect significant changes in patients after a one-month interval post-treatment, but responsiveness has not been properly investigated [53]. This tool should be used along with other scoring systems for disability, to get a complete assessment of pain [9]. The inter-rater reliability of MVAS is not to be relied upon as there is little correlation between results of observers [21]. It has good internal consistency for all its subscales except body functions which is an important aspect for disability caused by LBP. The strength of MVAS lies in its VAS scale usage that provides a strong unidimensional measure of pain severity. The NASS-LSO is a tool with which one can easily mark the regions of pain on a picture provided to the patient. Though complex to use and score, and extremely time-consuming, this tool, if used, can provide a very comprehensive picture of pain. The strength of this tool lies in its questions focussed on low back pain [9, 23].

Among the generic measures reviewed here, all three measures, namely BPI, MPI, and MPQ, are strong, reliable, and valid tools for LBP. BPI and MPQ are comprehensive but time-consuming. BPI is easy to score, while MPI is easy to administer. Internal consistency of MPI ranges from adequate to excellent, depending upon the language version used and the disease being studied. Construct validity of the tool too ranges from acceptable to excellent proving that all items being investigated serve the purpose of the tool. All three tools have cross-cultural use and show good responsiveness, with MPQ being extremely sensitive to detect change due to intervention. BPI shows high test–retest ability [28]. MPQ has the added advantage of including both nociceptive and neuropathic items of sensory pain dimension and is thus used for neuropathic LBP too. MPQ, MPI, and BPI are all used to assess diverse chronic pain conditions, including LBP, but BPI is the only tool that is formally validated for LBP, although not chronic LBP [66]. However, certain problems may arise in using BPI as patients' answers rely more on the disability caused by LBP in the recent past as opposed to the pain suffered, in general, during daily activities. In addition to this, when asked to fill the questionnaire, there may be a bias (patient-related) based on the patient's ability to bear the pain. The former can be overcome by noting the findings, in accordance with the questionnaire, after hearing the chief complaints of the patient. This prevents wastage of time and redundancy in the clinical queries. The latter can

Table 7 Mnemonic tools for quick assessment of acute pain

S. no.	Name of tool	Description	References
1.	SOCRATES	Site: Pain location? Onset: When did pain start and how quickly did it progress? Character: Dull, stabbing or sharp pain? Radiation: Does the pain spread to other body parts? Associations: Is pain present with other factors like nausea or movement difficulty, fever? Time: Is any pattern followed by the pain? Exacerbating/relieving factors: is pain worse at rest, movement or with certain basic functions like breathing? Surgical history: Any previous surgery or interventions?	[8]
2.	PQRST	*P* Precipitating factors *Q* Quality of pain *R* Radiating pain *S* Severity of pain *T* Temporal factor	[8]
3.	QISS-TAPED	*Q* Quality *I* Impact *S* Site *S* Severity *T* Temporal characteristics *A* Aggravating and alleviating factors *P* Past treatment, response and patient preferences *E* Expectations and meaning *D* Diagnostics and physical examination	[8]

be solved by blinding the patient to the assessment process which helps in getting more honest answers.

SF-36 is a very strong tool for the assessment of general health-related quality of life and also as an LBP tool. The tool's bodily pain and physical function correlate well with other disability tools, but the mental health subscale results are poor [38, 39].

Among the tools for assessing neuropathic pain, NPS seems like the only generic tool, apart from SF-MPQ-2, that has adequate validation and is widely accepted [27, 60]. This tool has good internal consistency and test–retest values as proven in a study by Rog et al. [60]. Though no formal responsiveness has been reported for this tool, and more confirmatory work is required on its psychometric properties, this tool has proven to be useful for assessment of neuropathic pain [27, 60].

Even in patients with dementia, a self-reported pain tool should always be the first attempt in order to estimate pain severity along with determining the presence or absence of pain, but due to the inability to execute the generic and condition-specific tools among these subjects, we must rely on observational measures. Among the tools for assessment of LBP among elderly or people who are cognitively impaired, all three tools have proven to be reliable, but no formal responsiveness has been tested for the tools. PAINAD shows excellent inter-rater reliabilities during pleasant and unpleasant activities [24] but poor to moderate reliability at rest or during movement [55]. It is thus very good at discriminating between different conditions like rest, movement, or pleasant and unpleasant activities, establishing a good construct validity [24, 55]. It shows good correlations with the pain and discomfort scale of VAS, and with DS-DAT. Internal consistency is poor and does not achieve the accepted limit of 0.70 Cronbach's α, but removing the item "breathing" or "negative vocalization" leads to an acceptable internal consistency of 0.75 [24]. Doloplus-2 shows high internal consistency and inter-rater reliability [57]. Test–retest values are extremely good, but this tool does not correlate well with other tools like PAINAD, VAS, and VRS [26]. APS shows good to excellent values for both inter-rater reliability and internal consistency, and removing the item "physical change" improves the fit of the tool, and thus its construct validity [56]. Both APS and Doloplus-2 show high sensitivity to change after a certain interval or intervention [58]. For acute pain assessment, unidimensional tools seem to be the norm, though tools like BPI and MPQ are also used considerably. CAPA, even with its limited psychometric data, has proven to be reliable, responsive, and most importantly, consistent in providing patient and staff satisfaction, as evident from the results of University of Utah Hospital [8, 64]. This tool needs to be tested more and across continents to attain a better understanding of its quality.

Conclusion

Every tool reviewed here has its own advantages and limitations. Recommendations would vary depending upon the language, disease condition, pain severity, and most of all the physician and patient using the tool. However, among the LBP-specific tools, RMDQ and ODI seem to be the ones most widely accepted and can help in clinical conditions like prolapsed intervertebral disc, infective spine, spondylosis, and spondylolisthesis. They need to be used in conjunction with a HRQoL tool like SF-36 or its derived version SF-12, but SF-36 can be used as an independent measure for LBP too. Among the generic tools for LBP, even though both BPI and MPQ are time-consuming, they have high reliability and validity. Our review points to a higher level of proven responsiveness for BPI as compared to MPQ. Also, BPI has been formally validated for LBP, making it the best generic tool for LBP management at present, in our opinion. For neuropathic LBP, more intervention studies are required to acquire data on the sensitivity of NPS. In the meantime, it can be used together with SF-MPQ-2 to get an accurate idea of the pain encountered. These neuropathic pain tools can evaluate neurological deficits which in turn can help to treat the patients conservatively or surgically. PAINAD, APS, and Doloplus-2 are all acceptable tools for cognitively impaired people and the choice of using one or more rests on the physicians. We understand that unidimensional tools, SF-MPQ-2 and CAPA, can all be used successfully for acute low back pain. Even the non-validated quick assessment mnemonic tools may not be irrelevant, as for acute pain, quick assessment and quick relief is the fundamental goal. Lack of formal validation of a pain tool has not stopped its worldwide use and acceptability in daily clinical practice. Rather, these mnemonic tools can help in the clinical evaluation of acute pain in orthopaedic diseases like prolapsed intervertebral disc, spinal canal stenosis, spondylosis and diseases like infective spine and ankylosing spondylitis. Finally, physicians and patients need to use the tool that is best suited for the specific condition and pain severity.

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Compliance with ethical standards

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