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The Single Assessment Numeric Evaluation (SANE) in Patients with Spine-Related Pain and Disability

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ABSTRACT

Objective: *Disability and pain are common complaints of patients seeking care for spinal disorders. The Neck Disability Index (NDI), Modified Low Back Pain Disability Questionnaire (MDQ), and the Single Assessment Numeric Evaluation (SANE) capture disability while the numeric pain rating scale (NPRS) aims to capture pain intensity. There is limited evidence evaluating the SANE, and pain relationships in patients with neck and back pain. The purpose of this study was to evaluate the correlations among these outcomes.*

Methods: *A retrospective study was initiated on patients with non-surgical back (n=104,108) and neck (n=53,012) episodes. Patients completed an initial and final MDQ or NDI and at least 1 of the following initial measures: resting NPRS, activity NPRS, or SANE. Pearson's correlations were used to test concurrent validity.*

Results: *Strong correlations were found between final MDQ and resting pain (r=0.51) and pain with activity (r=0.55). Final NDI and resting pain(r=0.53) and pain activity(r=0.55) demonstrated strong correlations. Moderate correlations were found between initial MDQ and pain at rest (r=0.43) and pain activity (r=0.43), final MDQ and SANE (r=-0.35), initial NDI and pain at rest (r=0.47) and pain activity (r=0.45), and final NDI and SANE (r=-0.33). Weak correlations were found between initial NPRS and SANE in the MDQ sample; however final NPRS and SANE scores had moderate correlations in both the MDQ and NDI samples (r=-0.36-0.29). No correlations were observed between initial NPRS and SANE in the NDI sample.*

Conclusions: *The NDI and MDQ scoring appears to be influenced by pain, which may limit precision in representing true ability or function. The improvement of SANE and pain correlations at final visit reflects the combined effects of pain reduction, enhanced functional capacity, and potential psychological adaptation over the course of therapy, allowing patients to more accurately assess their pain in relation to the recovery process.*

Keywords
Disability, Pain, SANE, Spine.

Introduction
Spine-related pain and disability are a common burden worldwide. Low back and neck pain prevalence continues to increase rapidly worldwide making them the leading musculoskeletal cause of years lived with disability [1,2]. To track patient progress and assess the effectiveness of interventions, clinicians routinely use patient-reported outcome measures (PROMs). Among the most used PROMs in spine care are the Neck Disability Index (NDI) and the Modified Low Back Pain Disability Questionnaire (MDQ), both of which quantify disability levels and incorporate pain into most of the items [3,4]. However, the inclusion of pain in these

measures may confound true functional disability with subjective pain experiences, limiting the precision of clinical decision-making [5].

An alternative to these multi-item legacy PROMs is the Single Assessment Numeric Evaluation (SANE), a one-question measure that asks patients to rate their affected body region as a percentage of normal function, without explicitly referencing pain [6]. While the SANE has shown good validity and responsiveness in extremity-focused research [7-10], its application in spine care is relatively unexplored. Early evidence suggests that the SANE may be moderately correlated with spine disability measures such as the NDI and MDQ, yet largely independent of patient-reported pain intensity [11]. This distinction raises an important question: Can the SANE be used as a stand-alone measure of ability in spine patients, thereby reducing redundancy in PROMs collection and improving efficiency in clinical settings?

Implementing PROMs in clinical practice remains a significant challenge despite widespread consensus on their value. According to systematic reviews by Briggs et al. [12] and Glenwright et al. [13], clinicians often cite limited time, lack of clarity on how to interpret PRO data, and difficulty integrating PROMs into workflows as major barriers to implementation. These obstacles to implementation contribute to inconsistent PROMs use and can reduce the utility of outcome data in both patient care and program evaluation. Clinicians may also perceive low value in measures that are redundant or overly time-consuming for patients to complete, further diminishing uptake [12].

The SANE measure, by virtue of its brevity and simplicity, offers a potential solution to many of these barriers. It minimizes patient burden, requires negligible training to administer or interpret, and integrates easily into electronic health record systems due to its single-item format. Unlike multi-item PROMs that demand completion of 10 or more questions, with many overlapping in content, the SANE provides a streamlined alternative that may increase clinician compliance and patient engagement [11]. If the SANE proves to be a valid and distinct measure of disability, particularly one independent of pain, it could offer a practical strategy to reduce data collection fatigue while maintaining clinical insight into a patient's functional status.

Therefore, the purpose of this study was to evaluate the correlations among legacy spine disability PROMs (NDI, MDQ), the SANE, and the numeric pain rating scale (NPRS) in a large, diverse spine-related patient population. It is hypothesized that the SANE would be moderately to highly correlated with MDQ and NDI and that the SANE would have less correlation to pain than the MDQ and NDI. By examining the extent to which these instruments reflect overlapping or distinct constructs, this research seeks to inform more efficient outcome tracking strategies in spine care. Ultimately, the findings may guide decisions about the necessity and redundancy of multiple PROMs, supporting a more streamlined and patient-centered approach to musculoskeletal rehabilitation.

Methods

Study Design

A retrospective observational study was conducted utilizing data from a national patient outcomes registry. The registry included patients who initiated outpatient physical therapy for spine-related conditions in 2022. The study aimed to assess the relationships among various patient-reported outcome measures (PROMs) collected during routine clinical care. The study protocol was reviewed and approved by the University of South Carolina Institutional Review Board (PRO00125665).

Participants

Inclusion criteria encompassed patients who completed either the Neck Disability Index (NDI) or the Modified Oswestry Low Back Pain Disability Questionnaire (MDQ) at the initial evaluation, along with at least one of the following initial measures: resting Numeric Pain Rating Scale (NPRS), activity NPRS, or Single Assessment Numeric Evaluation (SANE). Patients who completed both the NDI and MDQ during the same episode of care were excluded to prevent redundancy in regional disability assessment. For patients with multiple survey entries within a single episode, only the initial and final completed PROM scores were analyzed. Initial PROM was defined as the first visit with the physical therapist, while final PROM was defined as PROM within ± 7 days of the final billed therapy session. PROMs were completed prior to the start of care.

Outcome Measures

Pain Intensity was measured using the NPRS, where patients rate their pain on a scale from 0 (no pain) to 10 (worst imaginable pain) with respect to rest and activity. The NPRS has demonstrated strong reliability and validity in populations with low back and neck pain [14].

Disability was assessed using region-specific PROMs:

- The NDI consists of 10 items, each scored from 0 (no disability) to 5 (maximum disability), with the first item assessing pain intensity and the remaining items evaluating functional limitations [3]. The scoring system ranges from 0-50, with higher scores indicating greater disability.
- The MDQ similarly comprises 10 sections, each scored from 0 to 5, with the first section assessing pain intensity [4]. The scoring system ranges from 0-50, with higher scores indicating greater disability

Self-perceived function was evaluated using the SANE, a single-item measure where patients rate their affected body region as a percentage of normal function on a scale from 0% to 100%, with 100% indicating full function. The SANE has been validated across multiple anatomical regions, including the shoulder, hand, knee, and ankle [6-10].

Statistical Analysis

To assess the adequacy of our sample size, a post hoc power analysis was run using an anticipated moderate effect size of r=0.30 for correlation. The power analysis was conducted for a

desired statistical power of 0.80 at an alpha level of 0.05, returning a sample of 85. Consequently, the power analysis confirmed that both samples were sufficiently large to detect a moderate correlation with high statistical power.

Descriptive statistics were calculated for demographic and outcome variables. Pearson correlation coefficients were employed to examine the relationships between matched pairs of PROMs, specifically between pain intensity measures (resting and activity NPRS) and functional disability measures (NDI, MDQ, and SANE). Both initial and final PROMs were analyzed to assess the stability of these relationships over time. All assumptions were met, and all data were analyzed using statistical software R (Version 4.5.0). Statistical significance was established as a priori at $\alpha = 0.05$. Correlation coefficients of <0.30 weak, 0.30–0.50 moderate, >0.50 strong [15].

Results

There were 104,108 patients with non-surgical back pain and 53,012 patients with neck pain that began physical therapy in 2022 (Table 1). In the combined cohort, most patients were female (60%) with commercial (60%), Medicare (16%), or Medicaid (13%) insurance with a mean age of 53±18. Table 1 provides initial baseline values for all PROM measures. Final resting pain on average was 2.2±2.5 and final pain with activity was 5.4±3.0 for MDQ sample and 2.3±2.5 and 5.2±3.0 for NDI sample. Final disability for MDQ sample was 25.2±18.7 and for NDI was 24.6±17.9. Final SANE was 69.3±19.6 in the MDQ sample and 70.9±18.9 in the NDI sample.

Table 1: Demographic characteristics and initial baseline measures, summarized by all patients and by cohort.

	All Patients	Lower Back (MDQ)	Neck (NDI)
Count	157,120	104,108	53,012
Age	53±18	53±19	52±18
Initial PROM	-	34±19 (104,108)	35±18 (41,858)
Initial Resting Pain	3±3 (121,161)	3±3 (81,244)	3±3 (39,917)
Initial Activity Pain	7±2 (131,538)	7±2 (88,286)	7±2 (43,262)
Initial SANE	56±22 (2,705)	55±23 (1,834)	57±22 (871)
Sex			
Female	94,390 (60%)	60,888 (58%)	33,502 (63%)
Male	62,730 (40%)	43,220 (42%)	19,510 (37%)
Payer			
Commercial	94,689 (60%)	63,259 (61%)	31,430 (59%)
Medicare	24,422 (16%)	17,231 (17%)	7,191 (14%)
Medicaid	20,377 (13%)	13,631 (13%)	6,746 (13%)
Auto-Personal Injury	9,526 (6%)	4,333 (4%)	5,193 (10%)
Workers Compensation	6,467 (4%)	4,601 (4%)	1,866 (4%)
Other	1,639 (1%)	1,053 (1%)	586 (1%)

Values are represented as Mean ± Standard Deviation or Count (%), PROM = Patient Reported Outcome Measure. MDQ = Modified Low Back Pain Disability Questionnaire; NDI = Neck Disability Index.

For correlation analyses between PROMs, only patients with complete data for the relevant measure pairs were included. As a result, the sample size varies across correlation analyses due to missing data. These subsample sizes are noted in both Tables 1 and 2. Correlations range from moderate to strong (Table 2). Weak, non-significant correlations were found between both initial resting and activity pain and initial SANE in the MDQ sample ($p>0.05$). No correlations were observed between initial resting or activity pain and initial SANE in the NDI sample. Lastly, weak, non-significant correlations were found between initial MDQ and SANE and initial NDI and SANE ($p>0.05$).

Discussion

A key component of value-based, patient-centered care is the systematic measurement of clinical outcomes, particularly from the patient's perspective [16]. The use of PROMs has become standard practice in physical therapy; however, their utility is contingent on their ability to capture distinct and relevant constructs without introducing unnecessary burden [12]. In clinical contexts where PROMs are redundant or poorly differentiated, the value of data collection may diminish, and the likelihood of implementation may falter [13]. Our findings help to reinforce the need for efficient, non-redundant PROMs that accurately assess key constructs such as pain intensity and functional disability.

Our findings from a large clinical dataset of patients with non-surgical spine conditions suggest that the NDI and MDQ, while widely accepted as region-specific disability measures, demonstrate moderate to strong correlations with pain intensity. Our findings support previous psychometric evidence indicating that these instruments are influenced by pain-related items embedded in their structure. More specifically, the significant correlations may be impacted by the number of items on these PROMs that directly inquire about pain. Interestingly, the SANE, a single-item global function measure, demonstrated weak or no correlation with pain ratings both at rest and during activity during the initial visit, and showed moderate negative correlations with final NPRS rest and activity scores. This divergence implies that the SANE may represent a purer construct of function or perceived ability, independent of pain, specifically at initial assessment.

The weak or absent correlations between NPRS and SANE at the initial physical therapy visit with moderate correlative findings by the final visit may be explained by several factors that are rooted in changes in pain perception, function, and psychological adaptation over the course of rehabilitation. Pain sensitivity is often elevated in response to musculoskeletal injury [17]. As such these patients might be overwhelmed by the pain experience rather than focusing the initial concern on the functional considerations associated with the condition. Additionally, as therapy progresses improvements in pain and function [18,19] become present resulting in a more direct relationship between pain and perceived function. Similar to pain sensitivity, psychological factors, such as fear of re-injury or anxiety early on in the rehabilitation process can influence pain experiences, potentially skewing a patient's perception of pain and minimizing an accurate assessment of function [20].

Table 2: Correlation coefficients for the significant matched pairs of PROMs in both the back and neck pain populations.

Correlation Pair	Correlation Strength	Correlation coefficient (*r*) (95% CI)	*p*-value	Patient Count (n)
Back Pain Population				
Initial MDQ & Initial Resting pain	Moderate	0.43 (0.43, 0.44)	<0.001	81,244
Initial MDQ & Initial Pain with activity	Moderate	0.43 (0.42, 0.43)	<0.001	88,286
Final MDQ & Final Resting pain	Strong	0.51 (0.50, 0.51)	<0.001	59,022
Final MDQ & Final Pain with activity	Strong	0.55 (0.55, 0.56)	<0.001	64,116
Final MDQ & Final SANE	Moderate	-0.35 (-0.39, -0.31)	<0.001	1,632
Final Resting pain & Final SANE	Moderate	-0.29 (-0.34, -0.24)	<0.001	1,569
Final Pain with activity & Final SANE	Moderate	-0.36 (-0.41, -0.32)	<0.001	1,639
Neck Pain Population				
Initial NDI & Initial Resting pain	Moderate	0.47 (0.47, 0.48)	<0.001	32,336
Initial NDI & Initial Pain with activity	Moderate	0.45 (0.44, 0.46)	<0.001	34,851
Final NDI & Final Resting pain	Strong	0.53 (0.52, 0.54)	<0.001	23,479
Final NDI & Final Pain with activity	Strong	0.55 (0.54, 0.56)	<0.001	25,314
Final NDI & Final SANE	Moderate	-0.33 (-0.40, -0.26)	<0.001	683
Final Resting pain & Final SANE	Moderate	-0.33 (-0.39, -0.29)	<0.001	719
Final Pain with activity & Final SANE	Moderate	-0.35 (-0.41, -0.28)	<0.001	763

Considering that both the SANE and the NPRS are single-item instruments, they offer an efficient alternative to longer, multi-item tools such as the NDI and MDQ. In a clinical environment where digital literacy and time constraints are ongoing challenges, reducing the number and redundancy of PROMs may improve both compliance and workflow integration [7,12]. Furthermore, prior studies on implementation of PROMs consistently highlighted patient burden, technology limitations, and clinician uncertainty in interpreting PROMs as major barriers to sustained uptake [11,12]. The SANE's brevity and focus on global function address several of these barriers simultaneously.

From a clinical perspective, the study data supports a model wherein the initial NPRS and initial SANE can be used together to represent distinct constructs, pain intensity and function, respectively, while avoiding the redundancy of administering the NDI/MDQ and NPRS. These findings are also consistent with prior findings by Neeley et al. [21], who hypothesized that a limited number of well-targeted variables may sufficiently capture clinical progress in patients with low back pain. The implications for clinical practice and quality reporting from this study are substantial: by replacing longer tools with valid, distinct single-item measures, clinicians may improve data quality while reducing the risk of survey fatigue.

There are limitations to consider when interpreting these data. These data should be interpreted with respect to spinal patients. Future studies should investigate the generalizability to other populations. As a cross-sectional analysis of registry data, our study does not capture changes over time beyond the episode of care. Longitudinal validation is needed to determine whether the observed correlations between PROMs remain stable during and after clinical intervention. Additionally, because patients who completed both the NDI and MDQ were excluded to avoid redundancy, selection bias may have influenced the composition of our sample. The correlations in this study do not imply causation, there are potential confounders that may or may not influence these results, such as diagnosis subtype, chronicity, and BMI. Lastly, the reliance on real-world clinical data introduces variability in data collection practices across clinics and clinicians, which may have affected measurement consistency.

Conclusion

The NDI and MDQ demonstrated moderate to strong correlations with patient-reported pain at rest and with activity as measured by the NPRS. In contrast, the initial SANE showed weak or no correlation with pain, suggesting that it captures a different construct, likely functional ability, independent of pain intensity. While the NDI and MDQ are often used as disability measures, their scoring appears to be influenced by pain, which may limit their precision in representing true ability or function. The improvement of SANE and pain correlations at final visit reflects the combined effects of pain reduction, enhanced functional capacity, and potential psychological adaptation over the course of therapy, allowing patients to more accurately assess their pain in relation to the recovery process. Both the SANE and NPRS are single-item tools that are quick to administer and interpret, representing distinct domains of recovery and pain, respectively at initial visit. These findings support the use of SANE alongside the NPRS as a low-burden, efficient PROMs set in clinical spine care, potentially eliminating the need for longer, overlapping measures like the NDI or MDQ. Future work should evaluate whether this simplified approach to collecting PROMs captures change over time and supports clinical decision-making without sacrificing the quality of data collection.

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