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Original article

Concurrent validity of the single assessment numerical evaluation and patient-reported functional measures in patients with musculoskeletal disorders: An observational study

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ABSTRACT

Introduction: As patient-reported outcome measures (PROMs) continue to evolve as vital measures of patient status, it may be useful to identify efficiently, Single Assessment Numeric Evaluation (SANE) scores that are valid and related to the patient's specific functional needs.

Objective: To evaluate the concurrent validity between SANE scores and commonly used body region-specific functional PROMs, functional percentage change scores, and total visits in patients with musculoskeletal (MSK) disorders.

Methods: 479 patients completed the SANE and one of the following PROMs at physical therapy discharge: Modified Low Back Pain Disability Questionnaire [MDQ], Neck Disability Index [NDI], Penn Shoulder Score [PSS], International Knee Documentation Committee [IKDC], Lower Extremity Functional Scale [LEFS]. Pearson correlation coefficients were used to assess the relationship between SANE and the aforementioned outcomes and total visits.

Results: The SANE was moderately negatively correlated with the MDQ and NDI at discharge. There were high positive correlations between SANE and PSS and IKDC and moderate positive correlation between SANE and LEFS. The SANE and MDQ and IKDQ demonstrated low positive correlation for functional percentage change scores, and the SANE and NDI demonstrated moderate positive correlation for functional percentage change scores. For total visits outcome, there was a negligible negative correlation between SANE and MDQ and NDI at discharge.

Conclusion: The SANE exhibits acceptable concurrent validity across all investigated PROMs at physical therapy discharge. However, inconsistent relationships across body regions for functional percentage change and total visits suggest differences in these values as compared to raw discharge scores.

1. Introduction

Patient-reported outcome measures (PROMs) are defined by the National Quality Forum as 'any report of the status of a patient's (or person's) health condition, health behavior, or experience with healthcare that comes directly from the patient, without interpretation of the patient's response by a clinician or anyone else' (National Quality Forum, 2019). Providers often collect body-region specific PROMs assessing symptom severity and functional status as part of their routine physical examination of patients (e.g., Modified Low Back Pain Disability Questionnaire [MDQ], Neck Disability Index [NDI], Penn Shoulder Score [PSS], International Knee Documentation Committee [IKDC], Lower Extremity Functional Scale [LEFS]) (Fairbank et al., 1980; Leggin et al., 2006a; Fritz and Irrgang, 2001; Binkley et al., 1999; Irrgang et al., 2001). Routine collection of the region-specific PROMs in an episode of care provides the patient and clinician with important

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measures of functional progress (or lack thereof), informs clinical decision-making, and can even influence reimbursement (Weldring and Smith, 2013; Black, 2013). However, because of their length, PROM collection in an episode of care can be burdensome to patients, providers, and administrators (Black, 2013). The Single Assessment Numeric Evaluation (SANE) (Williams et al., 1999) was introduced as an efficient single-item survey that can be applied for assessing the functional status of a variety of orthopedic conditions related to the shoulder, back, knee, and ankle (Sueyoshi et al., 2017; Winterstein et al., 2013; Thigpen et al., 2018; Shelbourne et al., 2012; Hunt and Sherman, 2003; Wright and Cook, 2013).

The Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) (Mokkink et al., 2010) recommends that an adequate choice of PROMs in clinical practice and research should be made based on its measurement properties. Validity is one of these measurement properties that refers to 'the extent to which an instrument accurately measures what is supposed to measure' (Messick, 1980; Chiarotto et al., 2018). This measurement property encompasses three types of validity content validity, construct validity and criterion validity. In this paper, we focused on concurrent validity which is a subtype of criterion validity domain and is defined as a method that involves administering the test of interest and reference standard test at nearly the same time (Terwee et al., 2018; Jewell, 2014). Current evidence demonstrates that the SANE has moderate to high concurrent validity with other PROMs investigating function as a construct [i.e. MDQ (Wright and Cook, 2013), American Shoulder and Elbow Surgeons (ASES)] (Cunningham et al., 2015).

At present, selected PROMs are considered reference standards (proxy measures) of health profiles for patients. As PROMs continue to evolve as vital measures of patient condition, and as the burden of time demands for implementation of healthcare increase, it may be useful to identify efficient, single-item surveys (SANEs) that are similarly related to reference standard PROMs. Although the SANE was validated in comparison with other PROMs for specific populations, to our knowledge, no studies have examined its concurrent validity of a wide array of PROMs for a broad range of MSK conditions (Prinsen et al., 2018). Thus, this study aimed to evaluate the concurrent validity of the SANE and functional PROMs across patients with a wide array of MSK disorders (back, neck, shoulder, knee and hip).

The investigation of a wide range of PROMs of MSK conditions using a robust sample may provide more consistent information and better reflect the reality of the value of SANEs in clinical practice. All PROMs used in this study are accepted and validated instruments to measure functional constructs. For comprehensiveness, we considered two different mechanisms in which PROMS are reported in the literature, a) a final score (to reflect the correlation between the measures at discharge) (Cunningham et al., 2015; Saad et al., 2018; Pietrosimone et al., 2017), and b) a percent change from baseline (to reflect the rate of recovery percentage) (Wright and Cook, 2013; Vickers, 2001). In addition, the concurrent validity between SANE and total visits was investigated to identify whether patients who had improved also has a lower number of visits. We hypothesized that the SANE would show a high negative correlation with low and neck function measure scores (because lower PROM scores in these regions suggest greater function) and high positive correlation with shoulder, knee and hip function measure scores (because higher PROM scores in these regions suggest greater function) at discharge. We have also hypothesized that there would be a high negative correlation between SANE and total visits since more visits are likely associated with individuals who do not improve as markedly.

2. Methods

2.1. Reporting guideline

This study used the REporting of studies Conducted using Observational Routinely collected Data (RECORD) to guide the reporting (Benchimol et al., 2015).

2.2. Study design

The study was an observational design (retrospective database study), reviewed and approved by Pro0092671 Institutional Review Board.

2.3. Participants and setting

Baseline patient and clinical data for non-operative complaints related to the MSK disorders between 2016 and 2017 were extracted from the ATI Patient Outcomes Registry (atient Outcomes Regi, 2019), which is registered with ClinicalTrials.gov (NCT02285868) and the US Department of Health and Human Services Agency for Healthcare Research and Quality in the Registry of Patient Registries (2608). This involved an initial sample of 1137 individuals with acute (< 90 days) and chronic (≥ 90 days) complaints who were treated at one of multiple physical therapy clinics in South Carolina.

2.4. Treatment

Treatment was provided in a pragmatic fashion. All clinicians employed at the participating facilities had previously been educated in 6–8 h of online and in-person training. The goal of the educational session was to improve guideline-based practice and reduce variation in care. Best practice parameters were suggested following similar treatment-based approach, but there were no prescriptive elements to the care of patients (Denninger et al., 2017; Tate et al., 2010; McClure and Michener, 2015).

2.5. Descriptive variables

Patient characteristics were captured at baseline including age, sex, body mass index (BMI), comorbidities, baseline health-related quality of life (physical and mental components score) and baseline function. Health-related quality of life was measured by 12-item Veteran's RAND Health Survey (including physical and mental components scores), which corresponds to a reliable questionnaire developed from a modified version of the Short Form Survey (SF-36) (Kazis et al., 2004). Higher scores of the VR-12 indicate better health status (Selim et al., 2009). Description of all body-region specific PROMs (including their measurement properties) used to evaluate distinct MSK disorders are reported in Table 1.

2.6. Outcome measures

Outcome measures included: 1) the Single Assessment Numeric Evaluation (SANE) at discharge, 2) Body-region specific PROMs at discharge (Table 1), 3) PROM percentage change score and 4) Total number of visits. The SANE is a 1-item, valid and responsive measure that rates patients' perceived function requesting them to answer the question, "How would you rate your [body region] today as a percentage of normal (0%–100% scale with 100% being normal) (Williams et al., 1999; Thigpen et al., 2018). At present, the SANE has assessed for concurrent validity only in populations with shoulder, knee and low back dysfunction (Williams et al., 1999, 2000; Sueyoshi et al., 2017; Thigpen et al., 2018; Shelbourne et al., 2012; Wright and Cook, 2013; Cunningham et al., 2015). The outcomes were collected at the time of initial evaluation and follow up. Patients were provided with paper surveys upon arrival from the desk staff.

The International Classification of Functioning, Disability, and Health (ICF) defines disability as "is an umbrella term for impairments, activity limitations (difficulties an individual may have in executing activities) and participation restrictions (problems an individual may

Table 1
Description of functional PROMs used to evaluate the MSK disorders of interest.

Body-region	PROMs	Description	Total items/ range score	Score interpretation
Low back disorders	Modified Low Back Pain Disability Questionnaire (MDQ) (Fairbank et al., 1980; Fritz and Irrgang, 2001)	Provides information about how patients' back or leg pain affecting their ability to manage in everyday life. This questionnaire has good levels of reliability, content validity and internal consistency. (Fairbank and Pynsent, 2000)	10 items/0-100	0–20%: minimal disability 21–40%: moderate disability 41–60% severe disability 61–80% crippled 81–100%: patients are either bed-bound or exaggerating their symptoms
Neck disorders	Neck Disability Index (NDI) (Vernon, 2008)	Measures self-rated disability due to neck pain. This questionnaire has good levels of reliability, validity, internal consistency and responsiveness. (Vernon, 2008; Saltychev et al., 2018)	10 items/0–50.	0-4: no disability 5-14: mild disability 15-24: moderate disability 25-34 severe disability Above 34: complete
Shoulder disorders	Penn Shoulder score (PSS) (Leggin et al., 2006b)	Evaluates pain, satisfaction, and function. PSS has good levels of reliability, validity and internal consistency. (Leggin et al., 2006b)	24 items/ 0–100.	The total PSS maximum score of 100 indicates high function, low pain, and high satisfaction with the function of the shoulder
Knee disorders	International Knee Documentation Committee (IKDC) (Hefti et al., 1993)	Provides an overall function score through measures of symptoms, sports activity, and knee function. The IKDC has good internal consistency, test-retest reliability, content and structural validity, and responsiveness and interpretability. (Grevnerts et al., 2015)	10 items/0-100	Higher scores suggest greater function
Hip disorders	The Lower Extremity Functional Scale (LEFS) (Binkley et al., 1999)	Investigates whether patients' are having difficulties to perform any daily activity because of their lower limb problem. The LEFS has good levels of reliability and construct validity. (Binkley et al., 1999)	20 items/0-80	Higher scores suggest greater function

experience in involvement in life situations). It denotes the negative aspects of the interaction between a person's health condition(s) and that individual's contextual factors (environmental and personal factors)." (Bruyère et al., 2005) Functioning is defined by ICF as an umbrella term for body function, body structures, activities, and participation. It denotes the positive or neutral aspects of the interaction between a person's health condition(s) and that individual's contextual factors (environmental and personal factors). Based on these definitions, the most accurate terminology for the constructs measured by SANE and the PROMs would be functioning and/or disability. In order to facilitate the interpretation of scores' direction and the interpretation of the concurrent validity findings, we adopted the terminology of functioning. Each body specific PROM is scored in a unique manner, with higher values suggesting greater function at the hip, knee, and shoulder, and lower values suggesting greater function at the neck and back. We used the formula (baseline – discharge)/baseline*100 to calculate the percentage change score of MDQ and NDI and the formula (discharge – baseline)/discharge*100 to calculate the percentage change score of PSS, IKDC, and LEFS.

2.7. Data sources/measurement

The de-identified data from the ATI Patient Outcomes Registry were not re-coded or manipulated and represented the raw form of findings from clinical practice. Patient conditions were coded with ICD-10 codes consistent with low back, neck, shoulder, knee and hip disorders. We included patients with more than one diagnosis. Patients were excluded if initial or follow-up PROMs or SANE scores were missing or not completed. We refined the overall dataset to include only those subjects with initial functional scores, and follow-up discharge functional scores (to calculate the functional percentage change scores) and discharge SANE scores. Filtering data resulted in a final sample of 479 patients (42.1% of the original dataset).

2.8. Statistical methods

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 25.0 (Chicago, USA). Descriptive statistics (mean, standard deviation, frequency, and percentage) were performed to describe patient demographic and clinical characteristics at baseline. Pearson correlation coefficients (r), with 95% confidence intervals (CI) were calculated to assess the relationship, strength, and direction of the association between SANE and each functional PROM, functional percentage change scores and total visits. The statistical significance was defined as p-value < 0.05. Strength correlation was defined as negligible positive or negative correlation (r = 0.00 to 0.30), low positive or negative correlation (r= > 0.30 to 0.50), moderate positive or negative correlation (r= > 0.50 to 0.70), high positive or negative correlation (> 0.70 to 0.90) and very high positive or negative correlation (> 0.90 to 1.0). (Mukaka, 2012; Hinkle et al., 1988).

3. Results

3.1. Characteristics of participants at baseline

As stated, from the initial dataset registry of 1137 individuals, 479 patients with MSK disorders who received physical therapy treatment were included (Fig. 1). The sample included 175 patients diagnosed with low back pain, 140 with neck pain, 64 with shoulder pain, 78 with knee pain, and 22 with hip pain (Table 2). Study participants were predominantly female (79.33%), overweight (mean = 29.42, SD = 7.40), with a mean age of 48 years (SD = 12.11). Arthritis and high blood pressure were the most prevalent comorbidities per self-reported medical history among all patients. Overall, the baseline mean for the VR-12 scores demonstrated moderate health-related quality [PCS (mean = 39.49, SD = 5.64), MCS (mean = 39.04, SD = 5.98)]

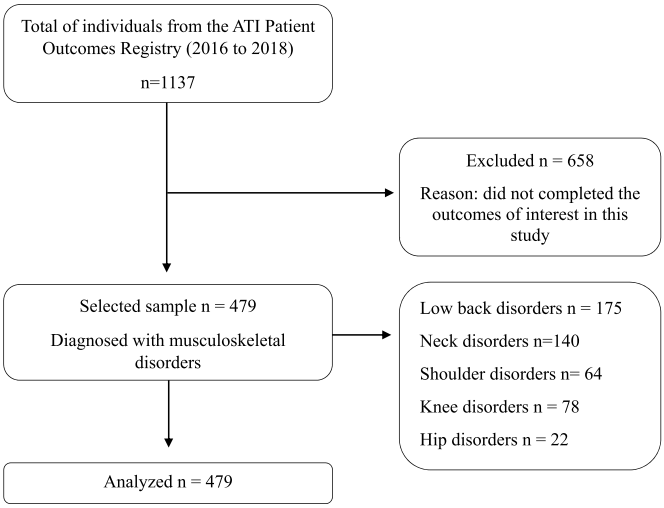

Fig. 1. Flow diagram of the study.

within population norms (Selim et al., 2009). Patients with LBP and neck pain initiated the treatment with minimal levels of disability (mean = 13.77, SD = 7.58), whereas patients with shoulder pain had a high disability (mean = 42, SD = 9.21) at baseline and patients with knee and hip pain had a moderate disability at baseline (mean = 48.29, SD = 16.19). Fig. 2 displays the means (SDs) of SANE and functional PROMs scores at discharge and total visits by body region.

3.2. Concurrent validity

Table 3, and Appendix 1 (scatter plots) display the results of concurrent validity correlation.

3.3. SANE score versus functional PROMs scores at discharge

There was negative correlation between SANE and MDQ ($r = -0.65$, $p < 0.01$) and NDI ($r = -0.63$, $p < 0.01$). Participants with higher SANE scores demonstrated a lower MDQ and NDI scores at discharge. There was high positive correlation between SANE and PSS ($r = 0.76$, $p < 0.01$) and IKDC ($r = 0.76$, $p < 0.01$) and moderate positive correlation between SANE and LEFS ($r = 0.66$, $p < 0.01$). Participants with higher SANE scores demonstrated higher PSS, IKDC and LEFS scores at discharge.

3.4. SANE score versus functional percentage change scores

There was low positive correlation between SANE and MDQ ($r = 43$, $p < 0.01$), moderate positive correlation between SANE and NDI ($r = 0.52$, $p < 0.01$) and low positive correlation between SANE and IKDC ($r = 0.43$, $p < 0.01$). There were non-significant negligible and low positive correlation between SANE and PSS and LEFS, respectively.

3.5. SANE score versus total visits

For total visits outcome, there was negligible negative correlation between SANE and MDQ ($r = -0.26$, $p < 0.01$) and NDI ($r = -0.20$, $p < 0.05$). There was a non-significant negligible negative correlation between SANE and PSS, IKDCregion-specific and LEFS.

Table 2
Patient demographic and clinical characteristics (n = 479).

Variables	Musculoskeletal disorders (body-region)				
	Low Back N = 175	Neck = 140	Shoulder N = 64	Knee N = 78	Hip N = 22
Age	47.0 (12.3)	46.1 (10.6)	47.6 (12.6)	46.4 (13.0)	50.3 (12.0)
Gender					
Female	137.0 (78.3)	126.0 (90.0)	38.0 (59.4)	60.0 (76.9)	19.0 (86.4)
Male	38.0 (21.7)	14.0 (10.0)	26.0 (40.6)	18.0 (23.1)	3.0 (13.6)
Body mass index	29 (6.2)	28 (6.7)	29.27 (7.0)	30 (8.6)	31 (8.5)
Baseline PCS of VR-12	39 (6.4)	38.3 (6.5)	39.1 (5.0)	40.3 (5.0)	40.7 (5.2)
Baseline MCS of VR-12	39.6 (7.0)	39.1 (5.7)	39.4 (5.0)	38.7 (6.5)	38.1 (5.5)
Baseline Function Score[a]	14.2 (8.6)	13.3 (6.4)	42.0 (9.2)	49.1 (16.0)	47.4 (16.4)
Comorbidities					
Arthritis	43.0 (24.6)	28.0 (20.0)	18.0 (28.1)	24.0 (31.0)	10.0 (45.5)
Asthma	22.0 (12.6)	13.0 (9.3)	3.0 (4.7)	6.0 (7.7)	5.0 (22.7)
Deep vein thrombosis	2.0 (1.1)	2.0 (1.4)	0 (0)	3.0 (4.0)	1.0 (4.5)
Cancer	9.0 (5.1)	11.0 (8.0)	4.0 (6.3)	1.0 (1.3)	4.0 (18.2)
Chest pain	4.0 (2.3)	5.0 (3.6)	3.0 (4.7)	0 (0)	0 (0)
Diabetes	18.0 (10.3)	17.0 (12.1)	8.0 (12.5)	4.0 (5.1)	1.0 (4.5)
Double vision	3.0 (1.7)	2.0 (1.4)	0 (0)	0 (0)	0 (0)
Fever nausea	2.0 (1.1)	4.0 (3.0)	0 (0)	1.0 (1.3)	1.0 (4.5)
Fracture	11.0 (6.3)	5.0 (3.6)	1.0 (1.6)	2.0 (2.6)	1.0 (4.5)
Heart condition	14.0 (8.0)	14.0 (10.0)	3.0 (5.0)	2.0 (2.6)	0 (0)
High blood pressure	42.0 (24.0)	33.0 (23.6)	15.0 (23.4)	16.0 (20.5)	5.0 (22.7)
Infection	1.0 (0.6)	5.0 (3.6)	1.0 (1.6)	0 (0)	1.0 (4.5)
Kidney disease	6.0 (3.4)	1.0 (0.7)	5.0 (8.0)	1.0 (1.3)	1.0 (4.5)
Osteoporosis	8.0 (4.6)	5.0 (3.6)	1.0 (1.6)	4.0 (5.1)	2.0 (9.1)
Psychological disorders	11.0 (6.3)	9.0 (6.4)	2.0 (3.1)	8.0 (10.3)	1.0 (4.5)
Smoking	8.0 (4.6)	8.0 (5.7)	3.0 (4.7)	6.0 (8.0)	0 (0)
Stroke	0 (0)	1.0 (0.7)	1.0 (1.6)	0 (0)	0 (0)
Unexplained weight of loss	1.0 (0.6)	0 (0)	0 (0)	2.0 (2.6)	0 (0)

PCS: physical component score, MCS: mental component score. VR: veteran's rand. Higher scores of the VR-12 indicate better health status.

[a] Measures: MDQ: Modified Low Back Pain Disability Questionnaire, NDI: Neck Disability Index, PSC: Penn Shoulder score, IKDC: International Knee Documentation Committee, LEFS: The Lower Extremity Functional Scale. MDQ (0–100) and NDI (0–50) measured low back and neck pain disability (lower score indicates greater function), PSS (0–100) measured shoulder disability (higher score indicates greater function), IKDC (0–100) measured knee disability (higher score indicates greater function) and LEFS (0–80) measured hip disability (higher score indicates greater function).

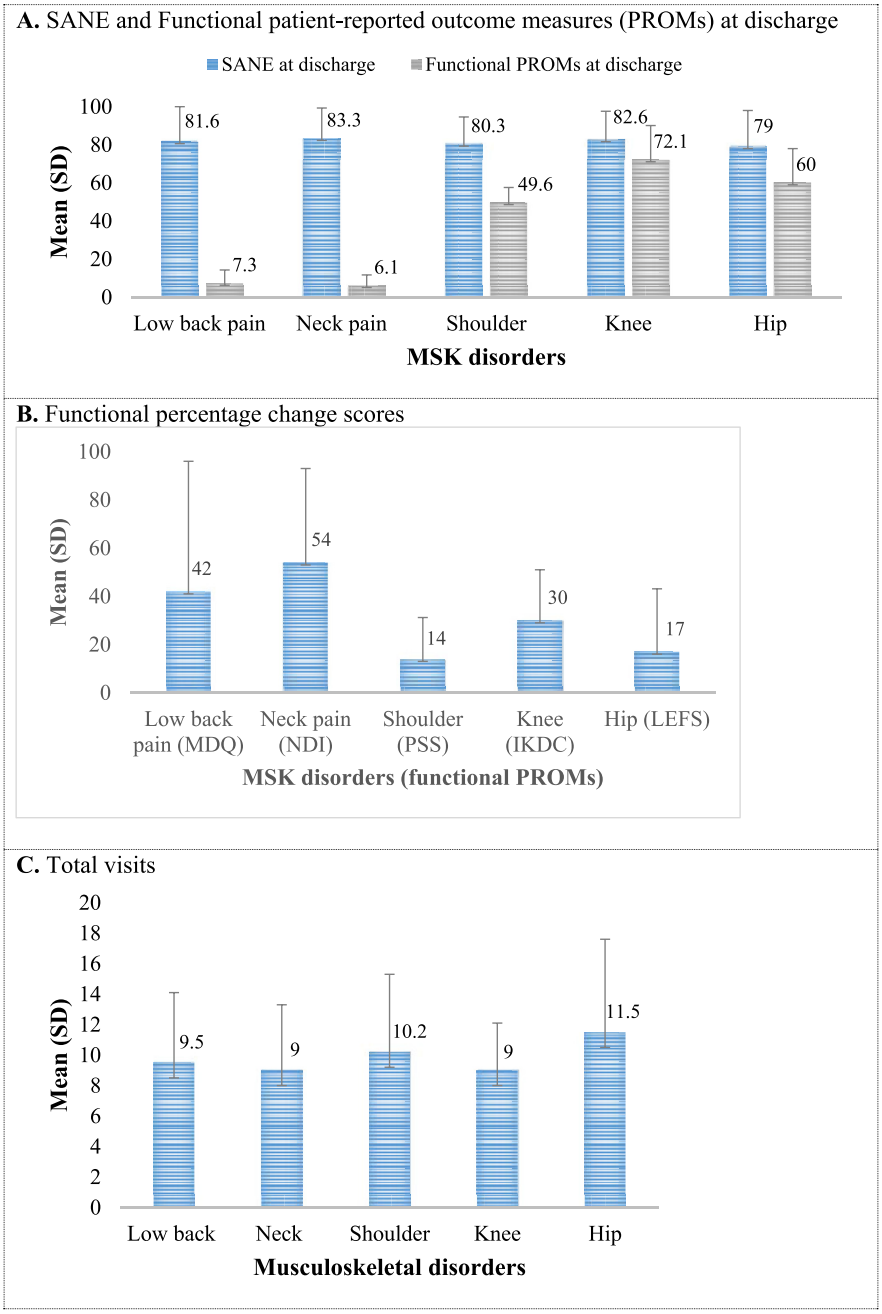

Fig. 2. Mean (SD) of SANE and functional PROMs scores at discharge (A), functional percentage change scores (B) and total visits (C). MDQ (0–100) and NDI (0–50) measured low back and neck pain disability (lower score indicates greater function), PSS (0–100) measured shoulder disability (higher score indicates greater function), IKDC (0–100) measured knee disability (higher score indicates greater function) and LEFS (0–80) measured hip disability (higher score indicates greater function).

4. Discussion

4.1. Summary of findings

In our study, we sought to evaluate whether the SANE could capture similar findings to functional PROM status at discharge, functional percentage change scores and total visits. The main finding of our study is the ability to demonstrate a moderately high correlation between the SANE scores and all functional PROMs at discharge. Our results also show negligible to moderate correlations between the SANE score and the MDQ, NDI, and IKDC functional percentage change scores, respectively. For total visits, our results show a negligible negative correlation between SANE and MDQ and NDI at discharge.

4.2. Comparison with other studies

We found a higher correlation between SANE and the PSS and IKDC measure scores and moderate correlation between SANE and the MDQ, NDI, and LEFS. Similarly, previous studies identified a high correlation between SANE and American Shoulder and Elbow Surgeons scores in rotator cuff and Superior Labrum Anterior and Posterior repairs (Cunningham et al., 2015) and after shoulder surgery (Williams et al., 1999), and between SANE and PF-CAT in sports medicine patients with shoulder disorders (Robins et al., 2017). Other studies demonstrated that the SANE score has moderate correlation with MDQ in patients with LBP who received physical therapy treatment (Wright and Cook, 2013), PROMIS Global-10 in rotator cuff pathology (Nicholson et al.,

Table 3
Concurrent validity correlations between SANE scores and functional PROMs.

SANE	PROMs	Pearson correlation coefficients (*r*)		
	Measure	Function at discharge	Functional percentage change scores	Total visits
Low back disorders	MDQ	−0.65**	0.43**	−0.26**
Neck disorders	NDI	−0.63**	0.52**	−0.20*
Shoulder disorders	PSS	0.76**	0.13	−0.11
Knee disorders	IKDC	0.76**	0.43**	−0.11
Hip disorders	LEFS	0.66**	0.41	−0.04

MDQ: Modified Low Back Pain Disability Questionnaire, NDI: Neck Disability Index, PSC: Penn Shoulder score, IKDC: International Knee Documentation Committee, LEFS: The Lower Extremity Functional Scale, SANE: Single Assessment Numeric Evaluation.
SANE = higher score indicates greater function.
MDQ and NDI = lower score indicates greater function (opposite direction to SANE).
PSS, IKDC and LEFS = higher score indicates greater function (same direction of SANE).
**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).
r 0.00 to 0.30 (−0.00 to −0.30): negligible correlation; *r* > 0.30 to 0.50 (−0.30 to −0.50): low positive (negative) correlation; *r* > 0.50 to 0.70 (−0.50 to −0.70): moderate positive (negative) correlation; *r* > 0.70 to 0.90 (−0.70 to −0.90): high positive (negative) correlation and r > 0.90 to 1.0 (−0.90 to −1.0): very high correlation.

2018), Rowe score in patients after shoulder surgery (Williams et al., 1999), IKDC in patients with knee disorders (Winterstein et al., 2013; Robins et al., 2017), the modified Cincinnati Knee Rating System (CKRS) after anterior cruciate ligament reconstruction and arthroscopy (Shelbourne et al., 2012) and Lysholm score in patients with anterior cruciate ligament reconstruction (Williams et al., 2000). In contrast, a few studies showed a low correlation between SANE and PROMIS Global-10 in patients with shoulder arthritis (Saad et al., 2018), the Western Ontario and McMaster Universities (WOMAC) in patients with knee arthritis (Pietrosimone et al., 2017) and Lysholm scores in patients who underwent total knee arthroplasty (Sueyoshi et al., 2017). We did not identify studies investigating concurrent validity in patients with neck and hip disorders.

4.3. Interpretation of the findings

The PROMs provide valuable information on the functional impacts of related health conditions, influence intervention strategies, and gauge efficacy and effectiveness of intervention strategies in clinical and research settings (Chiarotto, 2019). Our findings support our hypotheses that a single-item function measure captures findings consistent with improvements in function measured by a wide array of PROMs, mostly PSS and IKDC. It is worth noting that although SANE correlated well with all functional measures investigated at discharge, it does not mean that they measure identical constructs, but likely have overlapping conceptual elements to the patient. For instance, MDQ (Fairbank et al., 1980; Fritz and Irrgang, 2001), NDI (Vernon, 2008), PSS (Leggin et al., 2006b), IKDC (Hefti et al., 1993), and LEFS (Binkley et al., 1999) cover wide aspects of physical function (i.e., daily activities, self-care, vigorous physical activities, work-related activities, mobility) (Rose et al., 2008), whereas by proxy the SANE provides a general estimate of one's perception of normal wellbeing. Perhaps most importantly, although all PROMs generally allow the patients to define their health and wellbeing relative to a sequence of common functional demands, the SANE allows flexibility for the patients to define their overall status relative to their perception of “normal” which implies patient's expressed values and needs. In contrast, the standardized scales of the MDQ, NDI, PSS, IKDC, and LEFS allow less flexibility for the patient to define their present state. On the other hand, considering the complexity of recovery, which is most likely multidimensional, the assessor may not really know what the patient takes into account when making the rating of SANE. It is likely that patients will consider different aspects of their health to be relevant and will respond based on a varied set of parameters.

Because the routine collection of PROMs requires additional patient and clinician time and resources, it is often seen as burdensome to patients resulting in poor adherence to PROM collections programs (Winterstein et al., 2013; Shelbourne et al., 2012; Robins et al., 2017). Adopting the use of functional PROMs to benchmark patient status at baseline and discharge, and the use of SANE for intermediate and progression of care may minimize time burden on patients and staff, increase PROMs completion rates and facilitate the coordination and integration of care. We feel that at a minimum, the capture of a SANE routinely or each visit will better provide a comprehensive overview of a patient's self-report of their condition.

We have also identified a low positive correlation between SANE and MDQ and IKDC, a moderate positive correlation between SANE and NDI for a functional percentage change scores and a negligible negative correlation between SANE and MDQ and NDI for total visits. These results imply patients with a higher SANE score demonstrated a greater MDQ, NDI, and IKDC percentage change score and those with back and neck disorders demonstrated lower total visits. SANE did not capture functional change score in patients with shoulder and hip disorders. Similarly, SANE was not associated with total visits outcome in patients with shoulder, knee and hip disorders.

4.4. Study limitations

The results of this study should be interpreted within the context of the sample and limitations. A range of patients with varying degrees of MSK disorders and who received diverse physiotherapy treatment approaches was included in the sample. Further, the subjects included in the final analysis are a subset of a larger population who may have unique characteristics and outcomes. We compared the SANE score with only one function measure used to assess a specific disorder. It is possible that our results were more substantial if we had compared SANE with at least two functional measures or with function and psychological measures combined for each MSK disorder investigated. Pain intensity and psychosocial variables (i.e., depression, fear of movement, anxiety) were not available. Further, despite SANE correlated well with all functional measures at discharge, we did not identify a perfect correlation, which suggests that SANE may not reflect all aspects of physical function measured by the functional measures investigated. Finally, although SANE is commonly used in clinical practice, reliability and validity have not yet been thoroughly examined for all body regions/diagnostics (Thigpen et al., 2018; Robins et al., 2017; Sciascia et al., 2017).

5. Conclusion

The SANE exhibits acceptable concurrent validity in the back, neck, shoulder, knee, and hip with measures of MDQ, NDI, PSS, IKDC, and

LEFS. These findings suggest that a single-item function measure may capture a dimension of function in patients with a wide array of MSK disorders at discharge, mostly shoulder and knee disorders. Patients with higher SANE scores may have greater MDQ, NDI and IKDC change score. Finally, patients with lower back/neck disorders and higher SANE at discharge may have lower total visits. Adopting the use of functional PROMs to benchmark patient status at baseline and discharge and the use of SANE for intermediate and progression of care may minimize time burden on patients and staff and increase PROMs completion rates. More studies are needed to investigate concurrent validity between SANE, functional, and psychosocial measures at multiple time-points in patients with MSK disorders, mostly neck, back, and hip disorders.

Conflicts of interest

None declared.

Ethical approval

Pro0092671 Institutional Review Board.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.msksp.2019.102057.

References

ATI patient outcomes registry (accessed Jan 14 2019). https://www.atipt.com/ati-patient-outcomes-registry.

Benchimol, E.I., Smeeth, L., Guttmann, A., et al., 2015. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. PLoS Med. 12 (10), e1001885. https://doi.org/10.1371/journal.pmed.1001885.

Binkley, J.M., Stratford, P.W., Lott, S.A., et al., 1999. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. Phys. Ther. 79 (4), 371–383.

Black, N., 2013. Patient reported outcome measures could help transform healthcare. BMJ 346f167. https://doi.org/10.1136/bmj.f167.

Bruyère, S.M., Van Looy, S.A., Peterson, D.B., 2005. The international classification of functioning, disability and health: contemporary literature overview. Rehabil. Psychol. 50 (2), 113.

Chiarotto, A., 2019. Patient-reported outcome measures: best is the enemy of good (but what if good is not good enough?). J. Orthop. Sport. Phys. Ther. 49 (2), 39–42. https://doi.org/10.2519/jospt.2019.0602.

Chiarotto, A., Ostelo, R.W., Boers, M., et al., 2018. A systematic review highlights the need to investigate the content validity of patient-reported outcome measures for physical functioning in patients with low back pain. J. Clin. Epidemiol. 9573–9593. https://doi.org/10.1016/j.jclinepi.2017.11.005.

Cunningham, G., Ladermann, A., Denard, P.J., et al., 2015. Correlation between American shoulder and Elbow Surgeons and single assessment numerical evaluation score after rotator cuff or SLAP repair. Arthroscopy 31 (9), 1688–1692. https://doi.org/10.1016/j.arthro.2015.03.010.

Denninger TR, Cook CE, Chapman CG, et al. The influence of patient choice of first provider on costs and outcomes: analysis from a physical therapy patient registry. J. Orthop. Sport. Phys. Ther. 20171-26. DOI: 10.2519/jospt.2018.7423.

Fairbank, J.C., Pynsent, P.B., 2000. The oswestry disability index. Spine 25 (22), 2940–2952.

Fairbank, J.C., Couper, J., Davies, J.B., et al., 1980. The Oswestry low back pain disability questionnaire. Physiotherapy 66 (8), 271–273.

Fritz, J., Irrgang, J., 2001. A comparison of a modified oswestry low back pain disability questionnaire and the quebec back pain disability scale. Phys. Ther. 81 (2), 776–788.

Grevnerts, H.T., Terwee, C.B., Kvist, J., 2015. The measurement properties of the IKDC-subjective knee form. Knee Surg. Sport. Traumatol. Arthrosc. 23 (12), 3698–3706. https://doi.org/10.1007/s00167-014-3283-z.

Hefti, F., Muller, W., Jakob, R.P., et al., 1993. Evaluation of knee ligament injuries with the IKDC form. Knee Surg. Sport. Traumatol. Arthrosc. 1 (3–4), 226–234.

Hinkle, D.E., Wiersma, W., Jurs, S.G., 1988. Applied Statistics for the Behavioral Sciences. Cengage Learning.

Hunt, S.A., Sherman, O., 2003. Arthroscopic treatment of osteochondral lesions of the talus with correlation of outcome scoring systems. Arthroscopy 19 (4), 360–367. https://doi.org/10.1053/jars.2003.50047.

Irrgang, J.J., Anderson Af Fau - Boland, A.L., Boland Al Fau - Harner, C.D., et al., 2001. Development and validation of the international knee documentation committee subjective knee form. Am. J. Sports Med. 29 (5), 600–613. https://doi.org/10.1177/03635465010290051301.

Jewell, D.V., 2014. Guide to Evidence-Based Physical Therapist Practice. Jones & Bartlett Publishers.

Kazis, L.E., Lee, A., Spiro 3rd, A., et al., 2004. Measurement comparisons of the medical outcomes study and veterans SF-36 health survey. Health Care Financ. Rev. 25 (4), 43–58.

Leggin, B., Michener, L., Shaffer, M., et al., 2006a. The Penn shoulder score: reliability and validity. J. Orthop. Sport. Phys. Ther. 36 (3), 138–151. https://doi.org/10.2519/jospt.2006.36.3.138.

Leggin, B.G., Michener, L.A., Shaffer, M.A., et al., 2006b. The Penn shoulder score: reliability and validity. J. Orthop. Sport. Phys. Ther. 36 (3), 138–151. https://doi.org/10.2519/jospt.2006.36.3.138.

McClure, P.W., Michener, L.A., 2015. Staged approach for rehabilitation classification: shoulder disorders (STAR-Shoulder). Phys. Ther. 95 (5), 791–800. https://doi.org/10.2522/ptj.20140156.

Messick, S., 1980. Test validity and the ethics of assessment. Am. Psychol. 35 (11), 1–47. https://doi.org/10.1002/j.2333-8504.1979.tb01178.x.

Mokkink, L.B., Terwee, C.B., Patrick, D.L., et al., 2010. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. J. Clin. Epidemiol. 63 (7), 737–745. https://doi.org/10.1016/j.jclinepi.2010.02.006.

Mukaka, M.M., 2012. Statistics corner: a guide to appropriate use of correlation coefficient in medical research. Malawi Med. J. 24 (3), 69–71.

National Quality Forum Patient-reported outcomes (accessed Feb 02, 2019). https://www.qualityforum.org/Patient-Reported_Outcomes.aspx.

Nicholson AD, Kassam HF, Pan SD, et al. Performance of PROMIS global-10 compared with legacy instruments for rotator cuff disease. Am. J. Sports Med. 2018363546518810508. DOI: 10.1177/0363546518810508.

Pietrosimone, B., Luc, B.A., Duncan, A., et al., 2017. Association between the single assessment numeric evaluation and the western Ontario and McMaster Universities osteoarthritis index. J. Athl. Train. 52 (6), 526–533. https://doi.org/10.4085/1062-6050-52.5.07.

Prinsen, C.A.C., Mokkink, L.B., Bouter, L.M., et al., 2018. COSMIN guideline for systematic reviews of patient-reported outcome measures. Qual. Life Res. 27 (5), 1147–1157. https://doi.org/10.1007/s11136-018-1798-3.

Robins, R.J., Anderson, M.B., Zhang, Y., et al., 2017. Convergent validity of the patient-reported outcomes measurement information system's physical function computerized adaptive test for the knee and shoulder injury sports medicine patient population. Arthroscopy 33 (3), 608–616. https://doi.org/10.1016/j.arthro.2016.08.032.

Rose, M., Bjorner, J.B., Becker, J., et al., 2008. Evaluation of a preliminary physical function item bank supported the expected advantages of the Patient-Reported Outcomes Measurement Information System (PROMIS). J. Clin. Epidemiol. 61 (1), 17–33. https://doi.org/10.1016/j.jclinepi.2006.06.025.

Saad, M.A., Kassam, H.F., Suriani Jr., R.J., et al., 2018. Performance of PROMIS Global-10 compared with legacy instruments in patients with shoulder arthritis. J. Shoulder Elb. Surg. 27 (12), 2249–2256. https://doi.org/10.1016/j.jse.2018.06.006.

Saltychev, M., Mattie, R., McCormick, Z., et al., 2018. Psychometric properties of the neck disability index amongst patients with chronic neck pain using item response theory. Disabil. Rehabil. 40 (18), 2116–2121. https://doi.org/10.1080/09638288.2017.1325945.

Sciascia, A.D., Morris, B.J., Jacobs, C.A., et al., 2017. Responsiveness and internal validity of common patient-reported outcome measures following total shoulder arthroplasty. Orthopedics 40 (3), e513–e519. https://doi.org/10.3928/01477447-20170327-02.

Selim, A.J., Rogers, W., Fleishman, J.A., et al., 2009. Updated U.S. Population standard for the veterans RAND 12-item health survey (VR-12). Qual. Life Res. 18 (1), 43–52. https://doi.org/10.1007/s11136-008-9418-2.

Shelbourne, K.D., Barnes, Af, Fau - Gray, T., Gray, T., 2012. Correlation of a single assessment numeric evaluation (SANE) rating with modified Cincinnati knee rating system and IKDC subjective total scores for patients after ACL reconstruction or knee arthroscopy. Am. J. Sports Med. 40 (11), 2487–2491. https://doi.org/10.1177/0363546512458576.

Sueyoshi, T., Emoto, G., Yato, T., 2017. Correlation between Single Assessment Numerical Evaluation score and Lysholm score in primary total knee arthroplasty patients. Arthroplast. Today 4 (1), 99–102. https://doi.org/10.1016/j.artd.2017.09.004.

Tate, A.R., McClure, P.W., Young, I.A., et al., 2010. Comprehensive impairment-based exercise and manual therapy intervention for patients with subacromial impingement syndrome: a case series. J. Orthop. Sport. Phys. Ther. 40 (8), 474–493. https://doi.org/10.2519/jospt.2010.3223.

Terwee, C.B., Prinsen, C.A.C., Chiarotto, A., et al., 2018. COSMIN methodology for evaluating the content validity of patient-reported outcome measures: a Delphi study. Qual. Life Res. 27 (5), 1159–1170. https://doi.org/10.1007/s11136-018-1829-0.

Thigpen, C.A., Shanley, E., Momaya, A.M., et al., 2018. Validity and responsiveness of the single alpha-numeric evaluation for shoulder patients. Am. J. Sports Med. 46 (14), 3480–3485. https://doi.org/10.1177/0363546518807924.

Vernon, H., 2008. The neck disability index: state-of-the-art, 1991-2008. J. Manip. Physiol. Ther. 31 (7), 491–502. https://doi.org/10.1016/j.jmpt.2008.08.006.

Vickers, A.J., 2001. The use of percentage change from baseline as an outcome in a controlled trial is statistically inefficient: a simulation study. BMC Med. Res. Methodol. 16.

Weldring, T., Smith, S.M., 2013. Patient-reported outcomes (PROs) and patient-reported

outcome measures (PROMs). Health Serv. Insights 661–668. https://doi.org/10.4137/HSI.S11093.
Williams, G.N., Gangel, T.J., Arciero, R.A., et al., 1999. Comparison of the Single Assessment Numeric Evaluation method and two shoulder rating scales. Outcomes measures after shoulder surgery. Am. J. Sports Med. 27 (2), 214–221. https://doi.org/10.1177/03635465990270021701.
Williams, G.N., Taylor, D.C., Gangel, T.J., et al., 2000. Comparison of the single assessment numeric evaluation method and the Lysholm score. Clin. Orthop. Relat. Res. xx (373), 184–192.
Winterstein, A.P., McGuine, T.A., Carr, K.E., et al., 2013. Comparison of IKDC and SANE outcome measures following knee injury in active female patients. Sport Health 5 (6), 523–529. https://doi.org/10.1177/1941738113499300.
Wright, A.A., Cook, C.E., 2013. Criterion validation of the rate of recovery, single alphanumeric measure, in patients with low back pain. Physiother. Res. Int. 18 (2), 124–129. https://doi.org/10.1002/pri.1538.