Translation and Validation of the Danish Version of the Zurich Claudication Questionnaire

Jamal Bech Bouknaitir, MD1,2, Leah Y. Carreon, MD2, Stig Brorson, MD1, and Mikkel Østerheden Andersen, MD2

Abstract

Study Design: Validation study.

Objectives: To translate and validate the Zurich Claudication Questionnaire (ZCQ) into a Danish version of the disease-specific patient-reported outcome measure (PROM) for patients with lumbar spinal stenosis (LSS), which assesses symptom severity, physical function, and satisfaction after surgery.

Method: Translation into a Danish version of the original questionnaire by back- and forward-translating the questionnaire and finally transforming a prefinal test version into a final and cross-cultural adapted version. Validation was performed as a cohort study assessing floor-ceiling effects, internal consistency, test-retest reproducibility, criterion validity, discriminant validity, and responsiveness to change.

Results: Fifty-three patients were consecutively included in the study, 53 healthy controls were matched. Floor effect was seen in the postoperative data. Internal consistency, Cronbach’s alpha was good to excellent. Substantial test-retest reproducibility was found using Cohen’s weighted kappa. The Danish ZCQ showed moderate to strong association with similar domains of Oswestry Disability Index, Short Form 36, Euro QoL 5D, visual analogue scale–leg and back. The questionnaire showed significant responsiveness to change and a significant discriminant validity between LSS patients and healthy controls.

Conclusion: This study shows the Danish translation of the original ZCQ to be well understood by Danish patients. The Danish version is furthermore a reliable and valid questionnaire, which is responsive to change.

Keywords
Zurich Claudication Questionnaire, lumbar spinal stenosis, translation, validation, Danish version

Introduction

Lumbar spinal stenosis (LSS) is one of the leading indications for spinal surgery in Denmark.1 It is a degenerative disorder characterized by a narrow spinal canal compressing the spinal neurovascular structures causing leg pain, with or without back pain, leg numbness and gait disturbance.2,3 Lumbar spinal stenosis is a clinical syndrome. Patients report reduced functional capacity and the main symptom is neurogenic claudication expressed by reduced walking distance and leg pain aggravated by walking, relieved by sitting or leaning forward. Patients tend to walk in a stopped fashion also called “the shopping cart sign.”

The Zurich Claudication Questionnaire (ZCQ), also known as the Swiss Spinal Stenosis Measure or the Brigham Spinal Stenosis Questionnaire was developed in 1996 by Gerald Stucki et al.4 The ZCQ was designed specifically to develop a short, self-administered questionnaire assessing symptom severity, physical function, and patient satisfaction in LSS patients undergoing decompressive surgery. The questionnaire is disease specific and is divided into 3 main scales which address the clinical syndrome of LSS patients. The symptom

1 Zealand University Hospital, Kege, Denmark
2 Spine Center of Southern Denmark–Part of Lillebaelt Hospital, Middelfart, Denmark

Corresponding Author: Jamal Bech Bouknaitir, Spine Unit, Department of Orthopedic Surgery, Zealand University Hospital, Lykkebæk 1, 4600 Køge, Denmark.
Email: jabebou@gmail.com

Creative Commons Non Commercial No Derivs CC BY-NC-ND: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License (https://creativecommons.org/licenses/by-nc-nd/4.0/) which permits non-commercial use, reproduction and distribution of the work as published without adaptation or alteration, without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).
severity is focusing on balance disturbance, pain, and neuroischemic symptoms in the back and legs. Physical function mainly focuses on the patients’ ability to mobilize by walking. Patient satisfaction is focusing on patients’ overall satisfaction with the surgical procedure, pain relief, walking ability, and ability to do housework or job after the operation. Since its introduction, the ZCQ has become one of the primary outcome measures to report on treatment results in patients with LSS. The ZCQ has been translated and validated into several languages and has shown to be a reliable and valid diseasespecific questionnaire for patients with LSS. There have been 9 language translations, with over 120 articles published using the ZCQ. The questionnaire has not yet been culturally adapted and translated into Danish. The aim of this study was to translate and adapt the ZCQ from the original English version into Danish and to test the psychometric properties of the Danish ZCQ version. As LSS is common in the elderly, a Danish translation of the ZCQ is needed as English is not the primary language of our target population in Denmark.

Methods
This study was performed at the Center for Spine Surgery and Research, Lillebaelt Hospital, Denmark as a prospective cohort study including patients who had degenerative LSS and healthy asymptomatic controls. The study was approved by the Danish data protection agency (Ref. No. 16/1586) and the Ethical Committee of Medical Health Sciences, Region Sjaelland (Ref. No. SJ-505). All patients gave informed consent before participating in this study.

Questionnaire
The ZCQ is an 18-item, self-administered, disease-specific questionnaire and consists of 3 different domains: Symptom Severity, Physical Function, and Satisfaction. Higher scores denote higher degrees of dysfunction. All responses are reported on a Likert-type scale. The Symptom Severity domain consists of 7 items and is subdivided into a 3-item Pain subdomain and a 4-item Neuroischemic subdomain all with scale score 1 to 5, except from item 7, which has been transformed into a scale score 1-3-5. The 5 items in the Physical Function domain have scale score of 1 to 4 and the Satisfaction domain has 6 items with scale score 1 to 4. The domain scores are calculated as an unweighted mean of all answered items, if more than 2 items are missing the domain scores are also considered missing.

Translation
The guidelines used for translation and cross-cultural adaptation of the Danish ZCQ was published by Beaton et al and Guillemain and Bombardier and followed the recommendations published by ISPOR (International Society for Pharmacoeconomics and Outcomes Research) task force for translation and cultural adaptation.

The questionnaire was translated from English to Danish by 2 professional translators from an independent company (Ad-Astra). Both translators were naïve to the questionnaire, with no informed knowledge about the clinical perspective of the questionnaire. The translators made a forward translation T1 and T2, which was made from the source language to the target language and transformed into a T1-2 version. To improve applicability to the Danish population, item 8 was transformed from miles and blocks into International Metric System (IMS) in meters. The T1-2 version was reviewed by an expert committee of 2 spine surgeons and a research nurse with more than 30 years of experience and a language professional with more than 10 years of experience, all with Danish as their native language. The panel evaluated the Danish T1-2 version. The T1-2 version was backward translated into English (original language) by 3 bilingual individuals (both English and Danish): An orthopedic resident (not naïve to the questionnaire), a financial consultant, and an English teacher (both naïve to the questionnaire) made 3 versions BT1-BT2-BT3. This process is a validity check to make sure that the item content is the same as the original version. The 3 backward translations were evaluated and compared with the original version by the expert committee. After consolidating all versions of the translations, the committee created a prefinal version of the Danish ZCQ. Naïve translators were involved to increase acceptability and generalizability for patient use in the clinic setting. Nonnaïve translators were involved to ensure that the intent of the questions remained the same through the forward and backward translations.

Pretesting
The prefinal version of the Danish ZCQ was administered to a convenience sample of 50 patients who already had surgical decompression for LSS at the Department of Spine Surgery in Lillebaelt Hospital, Denmark from November to December 2015. The patients were able to answer all 3 domains in the questionnaire. The pretesting was made to evaluate the conceptual understanding exploring both the meaning of the items and the responses. We expected some of the patients would have reduced symptoms and increased functionality due to the surgical treatment, some would have remaining or even no changes in symptoms and disability. The prefinal version was tested using a wide variety of patients in order to evaluate the performance of the prefinal questionnaire across different age groups. Patients were asked to complete the ZCQ and to comment on confusing questions and potentially problematic sections. The expert committee addressed these potential issues and a final version of the Danish ZCQ was created and tested for reliability and validity.

Validation
The final version of the Danish ZCQ, the Short Form 36 (SF-36), Oswestry Disability Index (ODI), and European Quality of Life–5 Dimensions (EQ-5D) were administered...
Statistical Analysis

Domain score, total score, and mean values were calculated for the ZCQ. Floor and ceiling effects were evaluated by looking at percentage of participants scoring the minimum and maximum scores in each domain. Internal consistency was tested if the items in the domains or subdomains were homogenous and correlated and measuring the same concept. It was measured using Cronbach’s alpha coefficient (acceptable coefficient cut-off point >.7). Domain and subdomain internal test-retest reproducibility was determined by comparing the preoperative test and retest 14 days after using Cohen’s weighted kappa (agreement interpretation 0.1–0.20 = slight, 0.21–0.40 = fair, 0.41–0.60 = moderate, 0.61–0.8 = substantial, and 0.81–1.0 = almost perfect). This was supported by Bland Altman plots which are featured in the online supplemental materials) for the Symptom Severity domain, Pain subdomain, Neuroischemic subdomain, and Physical Function scale. Weighted kappa was used to take randomness into account and the further apart the test-retest answer is, the less weight is given to agreement.

Criterion-concurrent validity was evaluated by calculating Spearman correlation between the ZCQ and ODI, EQ5D, VAS-leg, and VAS-back, which was sent out 1 year postoperatively. To evaluate test-retest reproducibility, ZCQ was administered 14 days after the preoperative questionnaire, before surgery was performed, for comparison of Symptom Severity scores and Physical Function scores. The 14-day interval was introduced to reduce the risk of patients remembering their primary response. The Satisfaction domain was administered 14 days after the 6-month postoperative questionnaire and comparing only the satisfaction part of the postoperative questionnaire. At the same time, the final version of ZCQ was given to 50 healthy asymptomatic volunteers with Danish as their native language. They were recruited as the spouse to an LSS patient in the study. They were invited to participate if they had no previous history of spine surgery and felt they had a “healthy spine.”

Results

Translation and Cross-Cultural Adaptation

For the convenience sample of 50 patients who had surgical decompression for LSS, the mean age of the respondents was 66 years (range 19-86). None of the respondents reported the questions as confusing or saw any potential problematic sections. Sixteen respondents had written comments on their questionnaire, mainly regarding item 16, as they had only recently had surgery and had not begun physical activity. Respondents also commented on the Symptom Severity scale because the questions were addressing leg, feet, and back at the same time. Often patients would point out which part of the body they were referring to in their response.

Psychometric Testing of the Final Version

A total of 53 patients with LSS (Figure 1) completed the questionnaires. In the LSS group, 22 (42%) were females, mean age 66.7 years (range 39-85). The majority (92%) had leg pain symptoms for at least 3 months (Table 1). All the patients had a laminectomy only without a fusion. Fifty-three healthy asymptomatic volunteers (Figure 2) completed the questionnaires. In the LSS group, 22 (42%) were females, mean age 66.7 years (range 19-86). None of the respondents reported the questionnaire, mainly regarding item 16, as they had only recently had surgery and had not begun physical activity. Respondents also commented on the Symptom Severity scale because the questions were addressing leg, feet, and back at the same time. Often patients would point out which part of the body they were referring to in their response.

Floor Ceiling Effects. Although no ceiling effect was noted in any subdomain, a floor effect was seen in all the postoperative subdomains: Pain (25%), Neuroischemic (21%), Physical Function (29%), and Satisfaction (31%) (Table 2).

Internal Consistency and Test-Retest Reproducibility. Cronbach’s alpha for internal consistency was reported as good (Table 3)
except from the Neuroischemic subdomain (Cronbach’s $\alpha = .62$). Cohen’s weighted kappa for test-retest reproducibility was used looking at weighted disagreement for ordinal variables (Table 3) and showed substantial reproducibility for Symptom Severity Pain subdomain, Physical Function domain, and Satisfaction domain. Kappa for the Symptom Severity Neuroischemic subdomain was found to be moderate (kappa of $0.51$). This was supported by Bland-Altman plots in all scales and subdomains (Figure 3 Supplementary Material).

**Criterion Concurrent Validity.** The Danish ZCQ showed significant moderate to strong associations26 with similar domains of the ODI, SF-36, EQ-5D, VAS-leg pain, and VAS-back pain (Table 4). Spearman’s correlation coefficient for the ZCQ Pain subdomain and SF-36 Bodily Pain domain was $r = 0.68$, the ODI Pain domain was $r = 0.75$, EQ5-D Pain domain $r = 0.66$ and VAS-leg pain was $r = 0.67$. The correlation coefficient for the ZCQ Physical Function domain and the ODI Pain domain was $r = 0.61$, personal care was $r = 0.63$, sex life was $r = 0.68$, social life was $r = 0.70$ and Physical Function domains of the ZCQ and SF-36 were $r = 0.74$. Correlation between ZCQ Physical Function and EQ5D usual activity was $r = 0.57$ (Table 4).

**Responsiveness.** The questionnaire showed a significant responsiveness to change (Table 5) in both scales and all subdomains. The effect size and SRM (Table 5) were substantial for Symptom Severity score scale, Pain subdomain, Neuroischemic subdomain, and Physical function scale.

**Discriminant Validity.** The ZCQ showed a significant difference in scores between the patients and the healthy controls in all subdomains (Table 6).

**Discussion**

**Floor-Ceiling Effects**

As more than 20% of patients had the lowest scores possible in all subdomains, a floor effect is present. Floor and ceiling effects are present if more than 15% of scores are the minimum or the maximum possible score.22 This suggests that additional responses to the current items or new items may need to be added to the ZCQ in order to correct this floor effect. A similar floor effect at the 6-month postoperative follow-up period was found by Wertli et al7 in the Physical Function subdomain. Alternatively, the floor effect could be explained by patients reaching maximal improvement in their disease specific disability score 6 months after surgery.

**Internal Consistency**

The results of the current study showed good internal consistency for all domains and subdomains except for the Neuroischemic subdomain, in which the internal consistency was low at 0.62.27 This finding is similar to what was found in the original study by Stucki et al4 where Cronbach’s alpha for the Neuroischemic subdomain was .63. This is in contrast to the Spanish translation performed by Hidalgo et al,13 which showed good internal consistency for the Neuroischemic subdomain with Cronbach’s alpha of .796. Since there are only a handful of items that pertain to the different subdomains, any missing values will lead to the inability to separate the symptom severity scale into subdomains for unidimensional scores. A way of handling this issue could be to transform the
subdomains into actual scale scores and expand the number of questions.

Test-Retest Reproducibility
For the test-retest reproducibility, we found the Danish ZCQ to be reliable with a substantial weighted kappa coefficient in all domains except from Symptom Severity scale score and Neuroischemic subdomain, where we found a moderate weighted kappa coefficient (Table 3).

Concurrent Validity
The Danish version of ZCQ showed good concurrent validity especially when comparing similar dimensions of the questionnaires. This study is to our knowledge the only one separating both The ZCQ questionnaire and the generic questionnaires into subdomains (Table 4). For the subdomain scores, we found a strong correlation between ZCQ subdomain Pain and ODI Pain scores, SF36 Bodily Pain, EQ5D Pain scores and VAS-leg. A strong correlation was also found for overall Symptom Severity scale score tested against Generic Pain subdomains. No substantial correlation was found for ZCQ Neuroischemic subdomain.

We found a strong correlation between ZCQ Physical Function scale score and ODI Personal Care subdomain, Sex life, Social life, and ODI Total score, which was similar to what was found by Thornes et al, and a strong correlation between ZCQ Physical Scale score and SF-36 Personal Function, was also found by the Japanese group.

Responsiveness
Good responsiveness to change was seen with both effect sizes >1 and SRM >0.99 (Table 5). This supports the results seen in both the Norwegian and the Korean studies. Likewise, standardized response means were equal to or better than the original study by Stucki et al. Pratt et al showed the ZCQ and ODI questionnaires to be both responsive and reproducible, with ZCQ showing a slight superiority to the more generic ODI in terms of reproducibility.

Discriminant Validity
Data showed good responsiveness validity between patients treated for LSS in relation to healthy controls, which indicates that the questionnaire is measuring LSS as a disease specific questionnaire (Table 6). The results showed a statistically significant difference between the “case group” in relation to the “control group” for all subdomains in the ZCQ questionnaire.

Strength and Weaknesses
The major strength of the ZCQ is that it is disease specific, dealing with neurogenic claudication, the symptom that is pathognomonic for LSS. Comer et al performed a Rasch analysis on the ZCQ and showed that the Pain subdomain and the Neuroischemic subdomain had a good item and person fit, but highlighted that the Symptom Severity score was multi-dimensional with the 2 subdomains measuring 2 different latent variables. The current study is one of few psychometric studies separating the Symptom Severity scale into the unidimensional Pain subdomain and Neuroischemic subdomain.

To our knowledge, the Danish version of the ZCQ is the first disease-specific questionnaire for Danish patients with LSS. This study followed current guidelines.

The floor effect may be seen due to maximum improvement at the early 6-month follow-up. Furthermore, this may give

### Table 2. Descriptive Statistics: Case Domain Scores.

| Domain                | Mean  | SD    | Minimum | Maximum | % Floor | % Ceiling |
|-----------------------|-------|-------|---------|---------|---------|-----------|
| Preoperatively        |       |       |         |         |         |           |
| Symptom Severity score| 23.96 | 4.48  | 13      | 33      | 1.89    | 1.89      |
| Pain                  | 11.32 | 2.17  | 3       | 15      | 1.89    | 9.43      |
| Neuroischemic         | 12.64 | 3.15  | 4       | 18      | 1.89    | 3.37      |
| Physical Function     | 12.28 | 2.97  | 7       | 17      | 3.85    | 3.85      |
| Postoperatively       |       |       |         |         |         |           |
| Symptom Severity score| 15.35 | 5.89  | 7       | 28      | 15.38   | 1.92      |
| Pain                  | 6.87  | 3.06  | 3       | 12      | 25.00   | 7.69      |
| Neuroischemic         | 8.48  | 3.69  | 4       | 17      | 21.15   | 1.92      |
| Physical Function     | 8.10  | 3.05  | 5       | 17      | 28.85   | 1.92      |
| Satisfaction          | 10.13 | 4.27  | 6       | 24      | 30.77   | 1.92      |

### Table 3. Internal Consistency Coefficient and Reproducibility, Cronbach’s Alpha, Cohen’s Weighted Kappa: Zurich Claudication Questionnaire Domains and Subdomains.

| Domain          | Cronbach’ alpha | Weighted kappa (agreement %) |
|-----------------|-----------------|------------------------------|
| Preoperatively  |                 |                              |
| Symptom Severity score | .75           | .56 (88.16)                  |
| Pain            | .89             | .66 (92.48)                  |
| Neuroischemic   | .62             | .51 (87.50)                  |
| Physical Function| .84            | .74 (92.33)                  |
| Postoperatively |                 |                              |
| Satisfaction    | .93             | .64 (88.73)                  |
Table 4. Concurrent Validity, Spearman’s correlation and (p-value): Zurich Claudication Questionnaire, Short Form 36, Oswestry Disability Index, EuroQoL 5D, Visual Analogue Scale (Back and Leg).

| Domain         | ZCQ                                                                 |
|----------------|----------------------------------------------------------------------|
| SF-36          | Symptom severity | Pain | Neuroischemic | Physical function |
| PF             | −0.56 (0.000)     | −0.45 (0.001) | −0.51 (0.000) | −074 (0.000)      |
| RP             | −0.47 (0.000)     | −0.42 (0.002) | −0.40 (0.003) | −047 (0.000)      |
| BP             | −0.62 (0.000)     | −0.68 (0.000) | −0.45 (0.001) | −070 (0.000)      |
| GH             | −0.34 (0.013)     | −0.32 (0.0018) | −0.27 (0.055) | −043 (0.002)      |
| VT             | −0.34 (0.013)     | −0.40 (0.003) | −0.25 (0.074) | −039 (0.005)      |
| SF             | −0.41 (0.002)     | −0.49 (0.000) | −0.31 (0.018) | −053 (0.000)      |
| RE             | −0.31 (0.023)     | −0.18 (0.202) | −0.33 (0.017) | −033 (0.015)      |
| MH             | −0.49 (0.000)     | −0.47 (0.000) | −0.40 (0.003) | −045 (0.001)      |

ODI
1  6.1 (0.000) 0.75 (0.000) 0.44 (0.001) 0.61 (0.000)
2  0.57 (0.000) 0.60 (0.000) 0.45 (0.001) 0.63 (0.000)
3  0.35 (0.010) 0.28 (0.045) 0.31 (0.026) 0.36 (0.008)
4  0.27 (0.060) 0.19 (0.166) 0.27 (0.054) 0.59 (0.000)
5  0.39 (0.005) 0.35 (0.011) 0.32 (0.020) 0.33 (0.019)
6  0.39 (0.004) 0.39 (0.004) 0.31 (0.024) 0.58 (0.000)
7  0.45 (0.001) 0.48 (0.000) 0.31 (0.023) 0.50 (0.000)
8  0.58 (0.001) 0.50 (0.004) 0.52 (0.003) 0.68 (0.000)
9  0.48 (0.000) 0.50 (0.000) 0.37 (0.007) 0.70 (0.000)
10 0.48 (0.000) 0.46 (0.000) 0.41 (0.003) 0.57 (0.000)
Total: 0.58 (0.000) 0.57 (0.000) 0.47 (0.003) 0.76 (0.000)

Abbreviations: ZCQ, Zurich Claudication Questionnaire; SF-36, Short Form 36; PF, personal functioning; RP, roles–physical; BP, bodily pain; GH, general health; VT, vitality; RE, roles–emotional; MH, mental health; ODI, Oswestry Disability Index; EQ-5D, EuroQoL 5D; VAS, visual analogue scale.

Table 5. Responsiveness to Change, Effect Size, and Standard Response Mean (SRM): Zurich Claudication Questionnaire Domains and Subdomains.

| Domain                  | Preoperatively, mean (SD) | Postoperatively, mean (SD) | P   | Effect size | SRM  |
|-------------------------|---------------------------|----------------------------|-----|-------------|------|
| Symptom Severity score  | 24.02 (4.51)              | 15.35 (5.89)               | .000| 1.92        | 1.23 |
| Pain                    | 11.37 (2.17)              | 6.87 (3.06)                | .000| 2.07        | 1.23 |
| Neuroischemic           | 12.65 (3.18)              | 8.48 (3.69)                | .000| 1.31        | 0.99 |
| Physical function       | 12.47 (2.98)              | 8.04 (3.05)                | .000| 1.44        | 1.27 |

Table 6. Discriminant Validity: Zurich Claudication Questionnaire Domains and Subdomains.

| Domain                  | LSS, mean (SD) | Normal, mean (SD) | P   |
|-------------------------|----------------|-------------------|-----|
| N                       | 53             | 53                | NA  |
| Females                 | 22             | 30                | NA  |
| Preoperatively           |                |                   |     |
| Symptom Severity score  | 23.96 (4.48)   | 11.98 (6.10)      | .000|
| Pain                    | 15.10 (2.78)   | 7.30 (3.99)       | .000|
| Neuroischemic           | 9.07 (2.78)    | 4.68 (2.44)       | .000|
| Physical function       | 12.47 (2.78)   | 6.66 (3.17)       | .000|

Abbreviation: NA, not applicable.
reduced correlation when testing against questionnaires at 1-year follow-up.

**Conclusion**

This study shows the Danish translation of the original Zurich Claudication questionnaire to be a reliable and valid questionnaire, easy to understand, and responsive to change. The Danish ZCQ can be used to measure treatment effectiveness in patients with LSS. Additional responses to current items or new items may be needed to resolve both the floor effects seen in the postoperative domain scores and challenges with the multidimensional Symptom Severity scale score.

**Acknowledgments**

The authors thank Per Pallesen, MD, for supporting this study.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**ORCID iDs**

Jamal Bech Bouknaitir, MD https://orcid.org/0000-0002-6178-9805
Leah Y. Carreon, MD https://orcid.org/0000-0002-7685-9036
Stig Brorson, MD https://orcid.org/0000-0001-5337-758X
Mikkel Østerheden Andersen, MD https://orcid.org/0000-0001-8478-8218

**Supplemental Material**

Supplemental material for this article is available online.

**References**

1. Andersen M, Nielsen M, Bech-azeddine R. DaneSpine annual report 2017. http://drks.ortopaed i.dk/wp-content/uploads/2019/12/Arsrapport-DaneSpine-2017.pdf
2. Kreiner DS, Shaffer WO, Baisden JL, et al. An evidence-based clinical guideline for the diagnosis and treatment of degenerative lumbar spinal stenosis (update). Spine J. 2013;13:734-743. doi: 10.1016/j.spinee.2012.11.059
3. Ishimoto Y, Yoshimura N, Muraki S, et al. Associations between radiographic lumbar spinal stenosis and clinical symptoms in the general population: the Wakayama Spine Study. Osteoarthritis Cartilage. 2013;21:783-788. doi: 10.1016/j.joca.2013.02.056
4. Stucki G, Daltry L, Matthew LH, Lipson SJ, Fossel AH, Katz JN. Measurement properties of a self-administered outcome measure in lumbar spinal stenosis. Spine (Phila Pa 1976). 1996;21:796-803. doi:10.1097/00007632-199604010-00004
5. Kreiner DS, Shaffer WO, Summers J, et al. North American Spine Society evidence-based clinical guidelines for multidisciplinary spine care: diagnosis and treatment of degenerative lumbar spinal stenosis. Accessed July 28, 2020. https://www.spine.org/Portals/0/assets/downloads/ResearchClinicalCare/Guidelines/LumbarStenosis.pdf
6. Yi H, Wei X, Zhang W, et al. Reliability and validity of simplified Chinese version of Swiss Spinal Stenosis Questionnaire for patients with degenerative lumbar spinal stenosis. Spine (Phila Pa 1976). 2014;39:820-825. doi:10.1097/BR.S.0000000000000273
7. Wertli MM, Steurer J, Wildi LM, Held U. Cross-cultural adaptation of the German version of the spinal stenosis measure. Eur Spine J. 2014;23:1309-1319. doi:10.1007/s00586-014-3245-7
8. Thornes E, Grotle M. Cross-cultural adaptation of the Norwegian version of the spinal stenosis measure. Eur Spine J. 2008;17:456-462. doi:10.1007/s00586-007-0576-7
9. Tomaszewski KA, Klosinki M, Henry BM, et al. Large prospective validation and cultural adaptation of the polish version of the spinal stenosis questionnaire for patients with lumbar spinal stenosis. Ann Agric Environ Med. 2017;24:676-682. doi:10.26444/aaem/78674
10. Hara N, Matsuda K, Masuda K, et al. Psychometric assessment of the Japanese version of the Zurich Claudication Questionnaire (ZCQ): reliability and validity. PLoS One. 2016;11:e0160183. doi:10.1371/journal.pone.0160183
11. Marchand AA, Tettreau C, O’Shaughnessy J, Descarreaux M. French-Canadian adaptation and validation of the Swiss Spinal Stenosis Questionnaire for patients with lumbar spinal stenosis. Spine (Phila Pa 1976). 2019;44:E487-E493. doi:10.1097/BRS.000000000002896
12. Heshmati AA. Reliability and validity of the Swiss Spinal Stenosis Questionnaire for Iranian patients with lumbar spinal stenosis. Arch Bone Jt Surg. 2018;6:119-123.
13. Hidalgo Ovejero AM, Menéndez García M, Bermejo Fraile B, García Mata S, Forcén Alonso T, Mateo Sebastián P. Cross-cultural adaptation of the Zurich Claudication Questionnaire: validation study of the Spanish version. An Sist Sanit Navar. 2015;38:41-52. doi:10.4321/s1137-66272015000100005
14. Kim JJ, Lee YK, Kim DO, Chang BS, Lee CK, Yeom JS. Validation and cross-cultural adaptation of the Korean version of the Zurich Claudication Questionnaire in patients with lumbar spinal stenosis. Spine (Phila Pa 1976). 2018;43:E105-E110. doi:10.1097/BRS.000000000002241
15. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25:3186-3191. doi:10.1097/00007632-200012150-00014
16. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol. 1993;46:1417-1432.
17. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR Task Force for Translation and Cultural Adaptation. Value Health. 2005;8:94-104. doi:10.1111/j.1524-4733.2005.00454.x
18. Bjorner JB, Thunedborg K, Kristensen TS, Modvig J, Bech P. The Danish SF-36 Health Survey: translation and preliminary validity studies. J Clin Epidemiol. 1998;51:991-999. doi:10.1016/S0895-4356(98)00091-2
19. Lauridsen HH, Hartvigsen J, Manniche C, Korsholm L, Grunnet-Nilsson N. Danish version of the Oswestry Disability Index for patients with low back pain. Part 1: cross-cultural adaptation, reliability and validity in two different populations. *Eur Spine J.* 2006;15:1705-1716. doi:10.1007/s00586-006-0117-9

20. Lauridsen HH, Hartvigsen J, Manniche C, Korsholm L, Grunnet-Nilsson N. Danish version of the Oswestry Disability Index for patients with low back pain. Part 2: sensitivity, specificity and clinically significant improvement in two low back pain populations. *Eur Spine J.* 2006;15:1717-1728. doi:10.1007/s00586-006-0128-6

21. Sørensen J, Davidsen M, Gudex C, Pedersen KM, Brønnum-Hansen H. Danish EQ-5D population norms. *Scand J Public Health.* 2009;37:467-474. doi:10.1177/1403494809105286

22. Terwee CB, Bot SDM, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol.* 2007;60:34-42. doi:10.1016/j.jclinepi.2006.03.012

23. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 2012;33:159-174.

24. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. *Fam Med.* 2005;37:360-363.

25. Gwet KL. Intrarater reliability. *Methods Appl Stat Clin Trials.* 2014;(November):340-356. doi:10.1002/9781118596333.ch19

26. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. *Anesth Analg.* 2018;126:1763-1768. doi:10.1213/ANE.0000000000002864

27. Tavakol M, Dennick R. Making sense of Cronbach’s alpha. *Int J Med Educ.* 2011;2:53-55. doi:10.5116/ijme.4dfb.8dfd

28. Pratt RK, Fairbank JCT, Virr A. The reliability of the Shuttle Walking Test, the Swiss Spinal Stenosis Questionnaire, the Oxford Spinal Stenosis Score, and the Oswestry Disability Index in the assessment of patients with lumbar spinal stenosis. *Spine (Phila Pa 1976).* 2002;27:84-91.

29. Comer CM, Conaghan PG, Tennant A. Internal construct validity of the Swiss Spinal Stenosis Questionnaire. *Spine (Phila Pa 1976).* 2011;36:1969-1976. doi:10.1097/brs.0b013e3181fc9daf