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Neck Pain and Disability Scale: A Critical Evaluation

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### Summary

This article provides a review of current procedures for measuring cervical pain and dysfunction, and discusses some of the methodological issues involved in the measurement of chronic pain. In particular, the Neck Pain and Disability Scale [4] is compared to other measures of pain and disability and suggestions are made for further documentation of clinical and research usefulness.

Keywords: Neck Pain, Pain measurement, Disability, Cervical pain, Outcome assessment

## Neck Pain and Disability Scale: A Critical Evaluation

### *Background*

Neck Pain is a common complaint among adults. It has been reported to be a factor leading to disability and loss of work [1]. Efforts to measure the incidence have varied across subject populations but, in general, 35% to 50% of adults sampled have reported an episode of neck pain and its associated disability [2,3]. Clinical samples [4] generally include patients who have suffered from motor vehicle injury (40%), personal injury (14%), work-related injury (4%), and no injury (42%). Some [5] speculate that the neck pain and dysfunction is produced by involuntary muscle contraction. Muscle involvement is typically described as myofascial pain syndrome [6]. Although a variety of medical treatments have been proposed to alleviate pain in these muscular conditions, non-operative therapies are often ineffective and costly [7].

If pain is experienced for more than 3 months, it is considered to be chronic. Neck pain, like other kinds of chronic pain, is multidimensional. There are sensory aspects of the pain experience, an affective or emotional component, a pain intensity dimension, and an associated disability. To assess neck pain and disability either for clinical or research purposes, there are a variety of measures in use. Table 1 lists the measures used in recent research studies. Some scales are

general measures of pain that were developed to provide an overall index of pain and disability, like the Oswestry Disability Scale [8] or the Pain Disability Index [9], while others were developed specifically to assess chronic pain associated with the cervical spine. Also, there are differences among the measures in their degree of subjectivity and whether they were designed to assess single or multiple dimensions of the pain experience. The following review discusses the varied ways of measuring neck pain and provides some commentary regarding the reliability and validity of each approach.

#### *Pain Measures*

Muscle tenderness as measured by a spring-loaded pressure algometer [10] is a technique that is frequently used for assessing neck pain. This measure and range of motion [11] are the only ones that do not rely on self-report data. When used clinically, pressure algometry can identify trigger points. Pressure threshold measurements ( $\text{kg}/\text{cm}^2$ ) are taken on nontender muscles to serve as controls and then at symptomatic trigger points. Trigger points are focal areas where patients report pain in response to palpation over cervical soft tissue. Patients who complain of cervical pain can generally withstand more pressure on control areas than trigger points. A score can be calculated by taking the difference between the algometer scores of the control and the score at the most tender trigger

point. Generally, a difference greater than 2 kg/cm<sup>2</sup> indicates a trigger point. The algometer score depends upon the patient's pain threshold at selected locations on the upper spine.

Another measure that is in widespread use for both clinical and research applications is the visual analogue scale [12]. Patients are asked to rate the intensity or severity of their pain by placing a mark on a straight line anchored with verbal labels. Depending upon the verbal labels that are used as the anchors, the scale can be a reliable and valid measure of both sensory intensity and affective magnitude. Sensory intensity is measured when the visual analogue scale is anchored by no pain to the left and most severe pain on the right end of the scale. However, when not bad and the most intense bad feeling are used as the endpoints, then the scale can measure the affective magnitude of the pain experience. This scale, unlike any of the other self-report measures, is reported to be at the ratio level of measurement [12] because it uses the scaling technique of cross modality matching. Participants are asked to indicate the severity of their pain experience by matching it with a judgment of line length.

Recently, researchers have successfully developed self-report scales that are specifically designed to measure cervical pain and disability. The Copenhagen Neck Functional Disability Scale [13] is a 15-item questionnaire that measures neck

dysfunction, and the Northwick Park Neck Pain Questionnaire [14] is based on the Oswestry Disability Index and is composed of nine 5-part questions. Although all of the scales reported in Table 1 have demonstrated test-retest reliability and construct validity, two scales in particular have been used with several study populations—The Neck Disability Index [15] and the Neck Pain and Disability Scale [4].

The Neck Disability Index is a 10-item scale that assesses disability after injury to the cervical spine. It is a modified version of the Oswestry Disability Index and it is scored by summing the responses to each item and expressing the total score as a percentage of the maximum possible points. This scale has been used in different populations and has demonstrated reliability and validity when compared to more general measures of chronic pain and disability. The only problem that has been reported is that some researchers [16,17] have found that patients do not engage in some of the activities that are scaled and there is no standard procedure for dealing with the resulting missing data. For example, some patients seldom “read”, or had “associated headaches” and some did not “drive”.

The Neck Pain and Disability Scale is a more recent scale that was developed as a comprehensive measure of neck pain. When the data from a clinical sample of neck pain patients were

analyzed with a principal component factor analysis, the 20 items loaded to four factors and accounted for 76% of the variance. The first factor dealt specifically with problems with the neck, while the second measured intensity of pain. The effect of pain pills also loaded heavily to this factor. The third factor represented the affective dimension by measuring the effect of neck pain on emotion and cognition. The fourth factor measured the degree to which neck pain interfered with functional aspects of living. Patients respond to each item by marking along a 10-cm line that reflects the properties of a visual analogue scale. Item scores range from 0 to 5, in quarter-point increments. The total score is the sum of the item scores.

Recent studies [16,17] have compared these two measures to pressure algometry and to other more general measures of pain and disability (such as the physician and patients general assessment of improvement). Both of the measures have high test-retest reliability and good construct validity but the Neck pain and Disability scale was found to be a more sensitive index that measures multiple dimensions of the pain experience. In a study [16] that evaluated the treatment of neck pain with injections of either saline or Botulinum toxin, all of the outcome measures showed a significant benefit to treatment. However, there was considerable variation among the measures in

effect sizes. The Neck Pain and Disability Scale showed the largest effect size (Cohen's  $d = 1.40$ ), followed by pressure algometry (Cohen's  $d = 1.32$ ). The treatment effect size for the Neck Disability Index was more moderate (Cohen's  $d = .78$ ). Cohen's  $d$  estimates effect size by measuring the standardized difference between pre and post treatment scores. Effect sizes of less than .2 are generally interpreted as small, medium effect sizes would have a value of .5 and large effect sizes would have a value of .8 and above.

Another advantage of the Neck Pain and Disability Scale is that the total score can be divided into factor scores to determine whether the treatment has effects that are specific to one or more dimensions of the pain experience. Factor scores are computed by summing the scores for the items that load heavily on each of the rotated factors. The study [16] showed that two of the four factors (pain intensity and interference in life events) showed large treatment effects, while only moderate benefits were obtained with the other factors.

The multidimensional structure of the Neck Pain and Disability Scale has recently been revalidated with a French sample of chronic pain patients [17]. Using a translated version of the scales, the data were consistent in showing that the Neck Pain and Disability Scale had better construct validity than

either the Neck Disability Index or the Northwick Park Neck Pain Questionnaire.

A factor analysis of the French version of the Neck Pain and Disability Scale found three main factors that explained 78% of the variance. The first factor in the French scale corresponds to both problems with the neck and interference with functional aspects of living, while the second and third factor are similar to the factors extracted in the original analysis [4]—pain intensity and the presence and extent of associated emotional factors. Although there is a difference in the number of factors identified from the English and French samples, the dimensional structure of the two versions are close. The French study was successful at revalidating the multidimensional structure of the instrument and reaffirming the measure as one of the most sensitive ways of measuring the pain and disability associated with cervical pain.

Construct validity has also been affirmed by the evidence that the Neck Pain and Disability Index has well demonstrated convergent and divergent validity. Performance on the Neck Pain and Disability Index has been shown [4, 16, 17] to correlate more strongly with other pain measures, such as the Oswestry Disability Index and the Pain Disability Index, than with personality measures like the Beck Depression Inventory [18] and the Maudsley Neuroticism and Extroversion scale [19].

*Expert Opinion*

The Neck Pain and Disability Scale has shown some promise as a reliable and valid measure of chronic neck pain. When compared to other outcome measures it has been found to have the best construct validity and to be responsive to the improvements that result from treatments for chronic neck pain. The next step is to use confirmatory factor analysis to verify the factor structure of the instrument. Future testing needs to be done to test the fit of a 4 vs. a 3-factor model. The confirmatory procedures would be used to revise and refine the instrument as well as to clarify its multidimensional structure.

After the factorial structure is clarified, factor scores may then be used to test the degree to which treatments improve overall pain and disability or target specific dimensions of the pain experience. To some degree the factor scores may also be used to predict who may benefit from certain kinds of treatment. Such an instrument would have widespread clinical as well as research utility.

A review [20] of the recently developed self-report scales for measuring neck pain has summarized their psychometric properties. Almost all of the scales reported in Table 1 have good test-retest reliability. The self-report scales, whether used for clinical or research purposes, measure neck pain and its associated disability in a consistent and reproducible

manner. Moreover, each of the scales listed have some degree of construct validity as well, in that using the measures with pain patients indicate the extent of the neck pain and disability. However, the Neck Pain and Disability Scale has been shown in some recent studies to be a more sensitive measure when responsiveness to treatment is compared to other outcome measures.

#### *Five Year View*

Yet to be determined, however, is the usefulness of the factor solution. Do the factor scores provide information beyond that which is available from the total score? In the next 5 years, it will be necessary to test predictive validity for the factors in both research and clinical applications.

Also, the fact that the factor structure of the Neck Pain and Disability Scale was consistent across two versions of the instrument in two different languages suggests that the same constructs are measured. This findings helps to establish measurement invariance such that group differences accurately reflect differences on the latent characteristics assessed by the factors.

#### *Key Issues*

- There are at least 4 self-report scales that measure neck pain and disability with adequate psychometric properties.

- The Neck Disability Index and the Neck Pain and Disability Scale have been revalidated with several clinical samples.
- The Neck Pain and Disability Scale is the most sensitive index of neck pain and disability when compared to other self-report scales and to pressure algometry.
- Future studies are aimed at verifying the factor structure of the instrument and determining the utility of factor scores for clinical and research applications.

## References &amp; Reference Annotations

1. Cote P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in adults. *Spine*. 23(15), 1689-1698 (1998).
2. Barry M, Jenner JR. Pain in neck, shoulder and back. *Br Med J*. 310,183-186 (1995).
3. Bovim J., Schrader H, Sand T. Neck pain in the general population. *Spine*, 19, 1307-1309 (1994).
4. \*Wheeler AH, Goolkasian P, Baird AC, Darden BV. The development of the neck pain and disability scale: item analysis, face, and criterion-related validity. *Spine*. 24, 1290-1294 (1999). The Neck Pain and Disability Scale is published in this article.
5. Argoff, CE, Wheeler AH. Spinal and radicular pain syndromes. In: Backonja M-M (Ed.). *Neurologic Clinics*. W. B. Saunders, 833-845 (1998).
6. Simons, DG, Travell JG, Simons LS. Myofascial pain and dysfunction: the trigger point manual. Upper half of body. Williams and Wilkins. Baltimore, MD. Vol. 1 11-93 (1999).
7. Kurz LT. Nonoperative treatment of degenerative disorders of the cervical spine. In: Clark CR. (Ed.). *The cervical spine*. Philadelphia, PA: Lippencott-Raven, 779-783 (1998).

8. Fairbank JC, Cooper J, Davies JB, O'Brien JP. The Owestry low back Pain Disability questionnaire. *Physiotherapy*. 66, 271-273 (1980).
9. Chibnall JT, Tait RC. The pain disability index: factor structure and normative data. *Arch Phys Med & Rehabil*. 75, 1082-86 (1994).
10. Fischer AA. Pressure algometry over normal muscle: standard (145) values, validity and reproducibility of pressure threshold. *Pain*. 30, 115-126 (1987).
11. Youdas JW, Garrett TR, Suman VJ, Bogard CI, Hallman HO, Carey JA. Normal range of motion of the cervical spine: initial goniometric study. *Phys Ther*. 72,770-780 (1992).
12. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain*. 17, 45-56 (1983).
13. Jordan A, Manniche C, Mosdal C, et al. The Copenhagen Neck functional Disability Scale: a study of reliability and validity. *J Manipulative Physiol Ther*. 21, 520-527 (1998).
14. Leak AM, Cooper J, Dyer S, Williams KA, Turner-Strokes L, Frank AO. The Northwich Park Neck Pain Questionnaire devised to measure neck pain and disability. *Brit J Rheum*.33, 469-474 (1994).

15. Vernon, H, Mior, S. The neck disability index: A study of reliability and validity. *J Manipulative Physiol Ther.* 14, 409-415 (1991).
16. \*\*Goolkasian P, Wheeler AH, Gretz SS. The neck pain and disability scale: test-retest reliability and construct validity. *Clinical J of Pain.* 18,245-250 (2002). Provides evidence that the Neck Pain and Disability Scale is the most sensitive and responsive index of chronic pain and disability.
17. \*\*Wlodyka-Demaille S, Poiraudreau S, Catanzariti J, Rannou F, Fermanian J, Revel M. French translation and validation of 3 functional disability scales for neck pain. *Arch Phys Med Rehabil.* 83,376-382 (2002). A comparison of chronic neck pain instruments with a French sample.
18. Turner JA, Romano JM. Self-report screening measures for depression in chronic pain patients. *J Clin Psychol* 40, 909-913 (1984).
19. Knapp RH. *The Maudsley Personality Inventory, Administration and Scoring Manual.* San Diego: Educational and Industrial Testing Service (1962).
20. \*Pietrobon MD, Coeytaux RR, Carey TS, Richardson WJ, DeVellis RF. Standard scales for measurement of functional outcome for cervical pain or dysfunction. *Spine,* 27(5), 515-522 (2002). A review of 5 self-report scales for measuring neck pain.

Table 1

*Scales used in recent research to measure neck pain and disability.*

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**Self-Report Measures****General Pain**

Visual Analogue Scale (Price, 1983)

Oswestry Disability Index (Fairbanks et al, 1980)

Pain Disability Index (Chibnall & Tait, 1994)

**Neck Pain**

Neck Disability Index (Vernon & Mior, 1991)

Neck Pain and Disability Scale (Wheeler et al, 1999)

Northwick Park Neck Pain Questionnaire (Leak et al, 1994)

Copenhagen Neck Functional Disability Scale (Jordan et al, 1998)

**Other Measures**

Pressure Algometry (Fisher, 1987)

Range of Motion (Youden, 1992)

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