

Relationship Between Active Cervical Range of Motion and Perceived Neck Disability in Community Dwelling Elderly Individuals

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ABSTRACT

Purpose: The purpose of our study was to determine the relationship between perceived neck disability and active cervical range of motion (ROM). **Methods:** Twenty-three senior center attendees aged 60 to 90 participated. Their ROM was measured using the cervical range of motion instrument (CROM). Perceived neck disability was characterized using the Neck Disability Index (NDI). Pearson correlations were used to describe the relationships between CROM measurements and the NDI scores. **Results:** No CROM measurement was correlated strongly or significantly with the NDI score. The correlations ranged from 0.009 for left lateral flexion to 0.411 for right rotation. **Conclusions:** CROM and NDI measurements were not related. Impairments in variables other than cervical ROM may need to be addressed if the reduction of neck disability is intended in elders.

Key Words: neck, range of motion, disability, aging

INTRODUCTION

It is estimated that by the year 2030 there will be approximately 70 million individuals older than 65, with people 85 years of age and older comprising the fastest growing segment of the population.¹ Decreased range of motion (ROM) is an impairment that is known to accompany aging. Specifically, the cervical spine is one area in which losses in ROM are evident.²⁻⁴ Youdas et al reported per decade losses of 5° for neck extension and 3° for neck flexion, lateral flexion, and rotation.² Similarly, Hole et al found a decrease of 6° to 7° per decade for cervical extension, and a loss of 4° per decade in both cervical flexion and lateral flexion.⁵

These ROM losses may occur from inactivity and/or structural changes of the tissues in the cervical spine. With inactivity, there is an increase in connective tissue density, shortening of collagen tissue, and fibrosis of muscles.⁶ Osteophyte formation and narrowing of the intervertebral discs also accompany aging and immobilization.⁷ Reductions in cervical ROM have implications for safety and efficiency in functional activities. Decreases in cervical ROM lead to a loss in righting or protective reactions, which contribute to a loss of balance.⁸ Researchers have also shown that decreased cervical ROM is associated with poor driving ability.⁸⁻¹²

Two studies have previously noted a relationship of cervical ROM with neck disability. In the first, Riddle and Stratford¹³

examined the correlation of cervical ROM measurements with neck disability as measured by the Neck Disability Index (NDI) and health-related quality of life as summarized by the Mental Component Summary Scale (MCS) and Physical Component Summary Scale (PCS) of the Short-Form 36. They found correlations among various cervical ROM measures and the NDI to range from 0.27 to 0.40; they suggested that further study was needed in this area.¹³ In the second study, Herman et al performed canonical correlations between impairments as measured by pain, ROM, and force and disability as measured by NDI, MCS, and PCS.¹⁴ When only active cervical ROM and NDI scores were compared, an inverse relationship was observed, with a correlation of -0.54 .¹⁴

The varied results from these 2 studies may stem from differences in study methods and sample composition. Further research appears warranted to clarify the relationship between active cervical ROM and neck disability as indicated by the NDI. With evidence of such a relationship, attention to ROM might be supported. The topic of the current study was chosen in part because of recommendations included in section 1.2 of the Clinical Research Agenda published by the American Physical Therapy Association. That document suggests that additional studies be performed to determine the relationship between subjects' self-report of function and observed measures.¹⁵ Self-report of function questionnaires have a low cost, are easy, and capture a wide range of information. A common criticism of these questionnaires, however, is that they may not yield reliable and valid data. Another concern is that this type of subjective data may not equate well with objective clinical measures.

The purpose of this study was to further investigate the relationship between measured active cervical ROM and perceived neck disability, as measured by the NDI. Our hypothesis was that there would be an inverse relationship between cervical ROM measures and NDI scores; that is, as ROM measures decreased, NDI would increase.

METHOD

Participants

Participants were 8 men and 15 women age 60 to 90 (mean = 76.8) years, who were without previous neck surgeries or cervical fractures, and were able to read English. Participants were recruited at Tanglewood Senior Center in Lyndora, Pennsylvania.

Instrumentation

All cervical ROM measurements were taken with a Cervical Range of Motion instrument (CROM) (Performance Attainment Associates, St. Paul, Minn). The CROM attaches to the subject's head and contains 2 gravity goniometers and 1

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compass goniometer (Figure 1). Sagittal and frontal plane gravity goniometers measure flexion-extension and lateral flexion respectively. Rotation is measured by the compass goniometer in conjunction with a magnetic yoke. Youdas et al found intratester reliability of the CROM instrument ranged from 0.84-0.95 throughout the various planes of motion in a community dwelling population.⁴ Intertester reliability ranged from 0.73-0.92. Hole et al also found good intratester and intertester reliability for the CROM.⁵



Figure 1. Frontal (a) and lateral (b) view of a subject wearing the CROM instrument.

The NDI is a self-report of function questionnaire that is an adaptation of the Oswestry Low Back Pain Questionnaire.¹⁶ It has 10 subcategories that contain 6 statements; the respondent chooses the statement that best applies. Item scores, which range from 0-5, are totaled for a maximum possible score of 50. The NDI has been shown to have stable psychometric properties and high internal consistency.¹⁷ Vernon and Mior found a good test-retest reliability with a correlation coefficient of 0.89 ($P < 0.05$).¹⁶ They demonstrated a high internal consistency with a total index alpha coefficient of 0.80. They also showed construct validity by using a histogram of the range of scores; 83% were in the mild to moderate categories. Finally, they noted concurrent validity was also discovered to be high.

Procedure

We conducted a pilot study with 5 individuals to determine intraclass correlation coefficient of measurements obtained with the CROM. The intraclass correlation coefficients ranged from (0.951-0.968). Thereafter, a continuous sampling method was used to recruit participants for the study. A double-blinded recording method was used in order to ensure that both the researchers and the participants were not biased by the results. Participants gave informed consent to complete 2 questionnaires and perform 6 active cervical ROM movements.

During the initial phase of the study, participants were given a number to ensure confidentiality. Participants then completed the NDI questionnaire and the general information questionnaire, which contained subjective measurements of the participants' ability to perform daily activities. After all information was collected, the participants contin-

ued into the next phase, which involved the measurement of cervical ROM. Each participant began this phase by sitting in a standard folding chair and being fitted with the CROM (Figure 1). Before the ROM measurements were taken, all participants were asked to self-correct their posture by demonstrating the most erect posture they could achieve. The participants were then asked to rotate their heads as far as possible to one side and then a measurement was taken. The same procedure was completed for the opposite side, flexion, extension, and lateral flexion in a randomized order. The measurements were then taken again in the same order.

Data Analysis

All 10 subcategories of the NDI did not apply to all the participants of the study, resulting in the total score for some participants being less than 50. To accommodate for the nonapplicable items in the NDI, we followed the procedure of Haines et al and used the average score of the remaining items and assigned the average score to the nonapplicable subcategories.¹⁷ The nonapplicable items within the NDI were reading (1 subject), driving (4 subjects), and recreation (2 subjects).

Pearson product-moment correlation coefficients were used to quantify the linear relationship between each CROM measurement and scores obtained on the NDI. An a priori alpha level of 0.05 was set to determine statistical significance. The relationships were also observed graphically to assure that correlations were not depressed by nonlinear associations.

RESULTS

All descriptive statistics for the CROM measurements and NDI scores can be found in Table 1. Overall, CROM measurements were not strongly correlated with the NDI score (Table 2). The strongest relationship was found for right rotation ($r = 0.411, P = 0.051$).

DISCUSSION

The purpose of this study of community-dwelling elders was to further investigate the relationship between cervical ROM measurements and perceived neck disability as measured by the NDI. We hypothesized that ROM decreases would be a contributing factor to perceived disability, even though the NDI scale primarily measures pain associated with the performance of activities of daily living. Overall, strong negative correlations were not found to support our hypothesis. This could be because elders who participated

Table 1. Correlation of Cervical Range of Motion (ROM) Measures and Neck Disability Index Scores

ROM Measurement	Pearson Correlation	P-value
Flexion	0.062	0.778
Extension	0.272	0.209
Right Lateral Flexion	0.132	0.548
Left Lateral Flexion	0.009	0.966
Right Rotation	0.411	0.051
Left Rotation	0.163	0.457
No correlations are significant at the 0.05 level (2 tailed)		

Table 2. Descriptive Statistics of Cervical Range of Motion (CROM) and Neck Disability Index (NDI) Measurements

Measurement	Mean ± SD	Minimum -Maximum	CROM*
Flexion (°)	45.0 ±13.1	22.0 - 75.0	49.0
Extension (°)	41.8 ±9.8	22.5 - 61.0	58.0
Right Lateral Flexion (°)	29.0±9.2	9.5 - 42.0	30.0
Left Lateral Flexion (°)	25.0±10.0	9.0 - 45.0	30.0
Right Rotation (°)	51.8±10.7	28.5 - 69.0	55.0
Left Rotation (°)	49.5±8.7	30.5 - 64.0	55.0
NDI Driving Subcategory	0.3±.9	0 - 3.0	-
NDI Score (%)	10.5±11.9	0 - 44.0	-

*Normative mean values of range of motion of the cervical spine based on Youdas et al. 1992.³

were not particularly impaired in neck ROM or disabled as measured by the NDI.

This study had definite limitations. First, correlations between each cervical ROM measurement and NDI score may have been depressed by a lack of variability within the NDI scores. Lack of sensitivity of the NDI subcategories in this population may have occurred because some of the categories in the NDI questionnaire such as lifting, driving, work, and recreation did not apply to all of the participants tested. Also these individuals expressed difficulty in rating their levels of disability on tasks they did not perform daily. Another limitation of this study was that the NDI scale is used to subjectively assess neck pain associated with activity instead of general neck function and mobility. Since the NDI scale is one of the more common assessment tools used for subjectively quantifying neck dysfunction, it was the tool of choice in this study. However, only 5 out of 23 (21.7 %) participants in the present study suffered from neck pain on a regular basis. These results influence the relationship between pain, mobility, and disability. Even though pain is one of the more common reasons for disability it is possible that other measures such as ROM restrictions without pain can be a limiting factor contributing to disability if such activities require ROM outside the patient's ability.

The NDI has been shown in other studies to be a good index for functional disability in persons with neck pain.^{16,17} Pain is emphasized in the use of the NDI. However, the primary focus of the survey instrument on pain associated with function may limit its usefulness as ROM may be limited by factors other than pain. These additional factors may include soft tissue contracture, facet arthrology, and postural abnormalities. Future studies might include a larger sample of elderly individuals who are undergoing treatment for cervical spine disorders. Also, studies could investigate various diagnostic imaging results and their relationship with NDI scores. Additional research could focus on determining how much cervical ROM is needed to safely operate a vehicle and perform other tasks for daily living.

CONCLUSION

Low correlations were found between each CROM measurement and scores on the NDI. Whether the variables are

truly unrelated and whether other factors provide a better explanation of neck disability awaits clarification.

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