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## Neck Muscle Strength and Mobility of the Cervical Spine as Predictors of Neck Pain

*A prospective 6 year study*

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Reviewed by Dr. Shawn Thistle DC (Research Review Service)

### ABSTRACT

**Study Design:** *Follow-up study.*

**Objective:** *To study whether neck muscle strength or cervical spine mobility values could serve as predictors for future neck pain among originally pain-free working-age subjects during a long period.*

**Summary Of Background Data:** *Neck pain has been associated with weaker neck muscle strength and lower cervical spine mobility in several studies. However, causality between physical capacity and neck pain has not been shown.*

**Methods:** *Isometric neck muscle strength and passive range of motion of the cervical spine of 220 healthy female volunteers, aged 20 to 59 years, were measured. A postal survey was conducted 6 years later to determine whether any volunteers had experienced neck pain. The receiver operator characteristics curve was used to study how well the neck strength and mobility values in different movement planes at baseline served as predictors of future neck pain.*

**Results:** *Of the 192 (87%) responders, 37 (19%) reported neck pain for 7 days during the past year. In predicting neck pain, areas under the receiver operator characteristics curves (95% confidence intervals) in different movement planes were 0.52 to 0.56 (0.41-0.66) for isometric neck strength and 0.54 to 0.56 (0.44-0.76) for passive mobility of the cervical spine.*

**Conclusion:** *The results suggest that neither isometric neck muscle strength nor passive mobility of cervical spine has predictive value for later occurrences of neck pain in pain-free working-age women. Thus, screening healthy subjects for weaker neck muscle strength or decreased mobility of the cervical spine may not be recommended for preventive purposes.*

## ANALYSIS

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### **Background Information**

It is well known that neck pain is common and costly, resulting in considerable medical service consumption, disability and work absenteeism. When dealing with cervical spine pain in clinical practice, we often use simple measures such as spinal range of motion (ROM) and muscle strength for both assessment/diagnostic and outcome purposes. Some even use them as screening procedures on healthy patients in an attempt to identify those at risk for developing neck pain. Is this an evidence-informed approach?

Although the clinical importance of ROM is still controversial, there is evidence that those with neck pain tend to have weaker neck muscles than subjects without neck pain (1), suggesting that reduced neck strength could be a contributing factor in neck pain. To further support the relationship between neck pain and neck strength, the use of simple neck strengthening exercises has been shown to relieve neck pain in numerous clinical trials. As a result, neck exercise is now a front line treatment recommended for neck pain patients (2).

Overall, we are still unsure of the predictive value of reduced neck strength and mobility (ROM). The question is, do those with weaker necks and reduced cervical ROM stand a higher chance of experiencing future neck pain? The aim of this study was to determine whether neck muscle strength and/or passive mobility among pain-free, working-aged women could predict future episodes of neck pain.

## PERTINENT RESULTS

- Of the 220 women assessed at baseline, 87% (192) completed the follow-up at 6 years. There were no significant differences between those who responded at the 6 year mark and those who did not.
- Of the 192 respondents at 6 years, 81% (155) had experienced neck pain for  $\geq 7$  days or not at all in the 6 years since baseline (labeled as the NOP group), while 19% (37) had experienced neck pain  $> 7$  days duration (labeled as the NP group).
- The NOP and NP groups were similar in all baseline factors except workload (unfortunately, that data cell was blank in the final published version, so I am not sure which group had a higher work load – too bad, since this could be an important difference).
- *Strength*: at baseline, the average maximal neck flexion, extension and rotation strength measurements were 74.7 (Standard Deviation = 19.6) N, 200.0 (32.3) N, and 8.1 (2.2) N•m, respectively, in the NOP group and 72.8 (19.0) N, 196.0 (25.9) N, and 7.9 (2.0) N•m, respectively, in the NP group. There were no statistically significant differences between groups for neck strength ( $P = 0.38$  to  $P = 0.70$ ).
- *Range of Motion*: at baseline, the average (SD) range of motion for passive mobility of the cervical spine in the sagittal plane, frontal plane, and horizontal plane was 168.6 (SD = 18.8), 91.0°(14.8),

and 192.4 (20.1), respectively, in the NOP group and 164.9 (19.4), 87.8°(17.8), and 188.2°(18.0), respectively, in the NP group. There was no statistically significant difference between the groups ( $P = 0.26$  to  $P = 0.60$ ).

- *Predicting neck pain:* neither ROM nor isometric neck strength at baseline were able to reliably predict subsequent neck pain in this patient sample.

## **CLINICAL APPLICATION & CONCLUSIONS**

A recent literature review concluded that physical capacity and measures such as ROM and muscle strength or *endurance* were poor predictors of both future low back pain and neck pain (3). More specifically, the authors of that particular review found strong evidence that there is no relationship between the endurance of trunk musculature and the risk of LBP. However, they did report inconclusive evidence for a relationship between trunk muscle strength or lumbar spine mobility and the risk of lower back pain – more work is needed in this area. Due to a limited number of studies, inconclusive evidence for a relationship between physical capacity measures and a risk for neck or shoulder pain was reported. The authors of the literature review (3) appropriately mentioned the heterogeneity of the literature overall, mandating caution when interpreting their conclusions.

This study adds information regarding a relationship between physical capacity measures and future neck pain, suggesting that *neck pain cannot be predicted by isometric neck muscle strength or passive ROM measurements in healthy female subjects*. This should remind us that neck pain is a multifactorial condition, and that we should always consider not only the physical capacity of the individual as a potential risk factor, but also work-related physical and psychosocial risk factors, which have been shown to be potential predictors for future neck pain. At this time, it is not advisable to utilize cervical ROM and strength as screening tools to predict future neck pain. As always, further research is required on larger samples, as well as male subjects.

Lastly, the ‘*chicken and egg*’ argument regarding the relationship between neck pain and reduced cervical muscle strength remains unsolved.

## **STUDY METHODS**

### **Subjects**

220 women were recruited to participate in this study. Most worked for the city of Jyväskylä (Finland) in both white and blue collar capacities. To be included, the women had to be healthy. Subjects were excluded if they answered positively to questions on a screening questionnaire for any neck and shoulder pain experienced within the previous 6 months, previous or current neck injuries, and other disorders of the neck or shoulder area, or had arthritis, fibromyalgia, severe depression or mental disorder, or an active competitive sports career.

### **Outcome Measures**

At baseline, all subjects completed questionnaires regarding their general health, occupation, general activity levels, and the presence of neck pain in the previous 6 months. They also completed a Visual Analogue Scale (VAS), indicating their level of neck pain in the previous week (to ensure that they did not have current neck pain).

Neck strength was measured in flexion, extension, left and right rotation using an isometric neck strength measurement system (NSMS; Kuntoväline Ltd, Helsinki, Finland).

Passive neck ROM (left/right lateral flexion and axial rotation, flexion/extension) was measured using a cervical measurement system (CMS; Kuntoväline Ltd, Helsinki, Finland).

### **Follow-up**

6 years later, subjects received the same questionnaire package. They were asked whether they had experienced neck pain in the 6 years since baseline measurement. Details about neck pain such as duration, severity, medication use, healthcare consultation, accidents and illness were obtained.

## **STUDY STRENGTHS / WEAKNESSES**

### **Strengths**

- This is one of the longer prospective studies performed to date on this topic.
- The 87% follow-up rate was respectable and the authors did investigate for differences between responders and non-responders (there were no significant differences).
- At the 6 year follow-up, the authors used a 7 day limit to delineate coincidental, non-severe neck pain...this was a relatively arbitrary number, but did allow them to identify those with more severe incident neck pain – the very type practitioners utilizing strength and ROM would like to screen for (after all, neck pain prevalence is high, and many cases are non-severe).

### **Weaknesses**

- Although 6 years is an admirable follow-up period, a longer period may have revealed more cases of neck pain developing over time. Further, additional screening points within the 6 year follow-up may have improved accuracy of results and minimized recall bias at the 6 year point.
- The use of questionnaires alone relies on patient recall, which is not always accurate. Having said that, in a study such as this, questionnaires are an accepted and simple mechanism of collecting data.
- The study sample included volunteers, which may have biased the outcomes.

### **Additional References**

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