Hanvold TN, Waersted M, et al. The effect of work-related sustained trapezius muscle activity on the development of neck and shoulder pain among young adults. Scand J Work Environ Health 2013 in press

Design: Longitudinal cohort study

Population/sample size/setting:

- 40 young adults (23 women, 17 men) recruited from a population of 420 technical school students in the Oslo region
- Any technical student in Oslo appears to have been eligible, but participation was only a small fraction of technical students
    - 140 had withdrawn from school or had moved away from Oslo
    - 156 were reached by telephone, and 111 declined to participate, either because of lack of interest or because employer permission was not obtained
    - 45 were included in the study, but 5 were excluded because 2 cancelled their appointments with the researchers and 3 had technical deficits in the electromyography (EMG) readings needed for the baseline data
    - The study sample consisted of 15 female hairdressers, 14 male electricians, 5 female students, and 6 (3 male and 3 female) in other occupations

Main outcome measures:

- The goal of the study was to examine the relationship between trapezius muscle tension in the course of a working day (exposure) and the frequency/intensity of neck and shoulder pain over the subsequent 2.5 year period of follow-up (outcome)
- Trapezius muscle tension was measured once at baseline with a bilateral surface EMG which was worn by each participant for an average of 6 hours and 22 minutes at their jobs
- Sustained trapezius activity was defined as the percentage of time of the working day in which the EMG recorded activity more than 0.5% of the maximum EMG amplitude for more than four continuous minutes
- Neck/shoulder pain were assessed by questionnaires about every 4 months over the 2.5 year follow-up period
    - The questionnaires asked about neck and shoulder pain over the previous 4 weeks
        - Pain intensity was reported on a scale from 0=no pain to 3=severe pain
        - Duration was reported on a scale from 1=1 to 5 days of neck/shoulder pain to 4=15 to 28 days of neck/shoulder pain

    - The questionnaires also asked about working status and control over work intensity
        - Control meant that the workers said that they could control their own work pace and could determine the lengths of their work breaks
    - Additional work questions asked about repetitive movements, precision movements, material handling, vibration, and body postures
- The analysis of the data involved some specialized statistical methods for longitudinal data in which outcomes are repeatedly measured, looking for variation within subjects and for variation between subjects
- Trapezius tension as measured by the baseline EMG was divided into tertiles for purposes of analysis: low (0-29% of the day with more than 4 continuous minutes of EMG reading greater than 0.5% of maximum EMG, n=14), moderate load (30-49% of the day, n=13), and high (50-100% of the day, n=13)
- Most subjects remained in their same jobs for the entire 2.5 years of the study; 5 subjects changed work status (2 of whom were students who started to work)
- The essential finding was that the tertile with the high trapezius tension had more neck/shoulder pain than the tertile with low trapezius tension under several distinct analyses of the data
    - An analysis which adjusted for time, mechanical reported workload, control over work intensity, leisure physical activity, tobacco use, prior pain, and gender, showed that men with a high level of sustained trapezius activity had a rate of neck and shoulder pain 6 times that of the men with a low level of activity
    - An analysis of the short-term effect of trapezius sustained activity (the first 6 months) showed significant differences in neck/shoulder pain for both men and women, although the confidence intervals of the coefficients were wide
        - For men, the ratio for high vs low trapezius activity was 9.57 (95% CI from 1.88 to 48.68) and for women it was 7.82 (95% CI from 2.67 to 22.92)
    - The association between trapezius tension and neck/shoulder pain was greater in the earlier phases of the study than in later phases of the study
    - Even though there was considerable variability of neck/shoulder within individual subjects over the 2.5 years of study, the differences between the three tertiles of trapezius tension did not significantly vary
    - Sensitivity analyses were done in which the definition of trapezius muscle sustained activity was allowed to vary; changing the definition from 4 minutes to 2, 6, 8, and 10 minutes gave similar results

Authors' conclusions:

- Measured on a single working day, trapezius muscle activity pattern, with sustained activity for periods of >4 minutes, was associated with neck and shoulder pain over the following 2.5 years
- Even though only one EMG recording was made, there is evidence from other sources that muscle activity is stable over time in the same jobs; since there was very little change of job status over the period of study, the single EMG recording is likely to be reasonable
- Although other published studies reported no significant effect of trapezius EMG readings on neck and shoulder pain, these studies relied on static EMG recordings and did not look at the temporal pattern of activity as the current study did
- The results strengthen the hypothesis that sustained trapezius muscle activity is associated with neck and shoulder pain, which is strongest when reporting short-term effects

Comments:

- Even though the study sample is small, there are strengths of this study which are rarely seen in studies of work-relatedness of musculoskeletal pain
- The average age was not reported, but the population was probably in its early 20s as it graduated from trade schools in Oslo
- The exposure was measured objectively at the outset of the study and the analysis adjusted for potential confounders; in addition, several sound sensitivity analyses were done to ensure that the effect measures were robust as the cutoff times for trapezius activity were allowed to vary
- The effect sizes, even though there were wide confidence intervals, were large enough to be consistent with a causal relationship
- Some of the elements of the analysis were not discussed by the authors, but these may not be essential to the soundness of the conclusions
    - For example, the authors used nonparametric methods like the Mann-Whitney, Kruskal-Wallis, and Spearman correlation for some analyses, but used Generalized Estimating Equations, derived from a generalized linear model for other analyses
    - 17 of the participants (42.5%) reported some pain at baseline (prevalent cases) , but the analyses reported incidence rate ratios, which would be expected to mean the occurrence of new onset of pain
        - This could happen if a participant who did not have pain at the start of one of the 4 month follow-up periods developed pain at the end of that period
        - Since there was considerable within-subject variation in pain over the study period, it is likely that “incident” pain could be captured with the

generalized estimating equations in the analysis; this was not clearly elaborated on by the authors

- Overall, the study has enough advantages in design, measurement, and analysis to provide evidence of sustained trapezius muscle activity being a predictor of neck and shoulder pain at later times

Assessment: Adequate for some evidence that sustained activity in the trapezius muscle measured by surface EMG predicts neck and shoulder pain at later times