**Svendsen SW, Gelineck J, et al. Work Above Shoulder Level and Degenerative Alterations of the Rotator Cuff Tendons. A Magnetic Resonance Imaging Study. Arthritis Rheum 2004;50:3314-3322.**

Design: Cross-sectional study

Study question: Does work above shoulder level increase the risk of rotator cuff tendinitis?

Population/sample size/setting:

- The total study population consisted of 136 men from three trade groups in Denmark: machinists (n=42, mean age 46), car mechanics (n=49, mean age 46), and house painters (n=45, mean age 46) who had worked as journeymen for at least one year in their trade
    - Inclusion criteria were age 40 to 50, right-handedness, work as a journeyman for at least 10 years in one of the trades, weight <=120 kg, no shoulder-intensive sports, no history of traumatic shoulder injury, no thyroid disorder, no general debility
    - Some contraindications to MRI were exclusion criteria: claustrophobia, suspected metallic foreign objects, and implanted pacemaker

Quantification of exposure:

- From each of the three occupational groups 13 pairs of workers were sampled at random for measurement of upper arm elevation; 26 machinists, 23 car mechanics, and 23 house painters had these measurements completed (reported in Svendsen, Bonde, et al 2004)
- Whole-day measurements of elevation were done for four consecutive working days for these 72 participants
    - Arm elevation was measured with an inclinometer with a sensor attached to each upper arm and a data logger in the belt
    - Upper arm elevation was measured with respect to gravity in of 15° intervals from 0 to 90°, and there was a separate category for arm elevation greater than 90°
- Force requirements were assessed with a torque index using force scores assigned by "experienced tradespeople"
- For each of the three trades, a "reduction factor" was assigned to jobs with special functions: for example, the reduction factor was 0.25 if a car mechanic had a job as a foreman
- Lifetime upper elevation above 90° was assessed by combining the exposure for each job in the worker's history, a reduction factor when necessary, and the total duration of employment across all jobs

    - This led to a single measure of lifetime upper arm elevation as the number of full-time working months with the arm elevated above 90°

Outcome assessment:

- 136 men had MRI of the dominant shoulder on a 1.5 T machine using a dedicated shoulder coil with the humerus in mild external rotation
    - 23 of the house painters also had MRI of the nondominant shoulder; the machinists and car mechanics did not have an MRI of the nondominant shoulder
- Dominant shoulder images were evaluated by 2 musculoskeletal radiologists blinded to exposure status and symptoms
- Alterations in the supraspinatus, infraspinatus, and subscapularis tendons were graded; the supraspinatus muscle, acromioclavicular joint, glenohumeral joint, humeral head, and subacromial-subdeltoid bursa were also evaluated
- In order to obtain a measure of reliability, a random sample of 40 dominant shoulder MRI images were examined a second time with a five day interval between readings, with reliability between MRI readings measured with the kappa statistic
    - The kappas were good (0.64) for tendinopathy and moderate (0.50) for both A-C joint degeneration and for humeral head cysts

Analysis of causal relationships:

- The supraspinatus tendon was graded as normal in 84 (61.7%) of cases, and some grade of tendinitis was present in the other 52 workers (38.3%)
    - For acromioclavicular joint degeneration, 49.3% were normal and the rest abnormal
    - For humeral head cysts, it was also the case that 49.3% were normal and the rest abnormal
- Supraspinatus tendinopathy was associated with lifetime upper arm elevation
    - The odds of tendinopathy (all 52 cases) were increased by a factor of 1.27 for every five months of lifetime elevation of the upper arm above 90° (95% confidence interval between 1.02 and 1.60)
        - For >= 20 months of lifetime upper arm elevation above 90° (19 cases), the odds ratio was 2.33 (95% confidence interval between 0.93 and 5.84)
- A-C joint degeneration was not associated with upper arm elevation above 90°; the opposite was true (odds ratio for >= 20 months of exposure was 0.49)
    - Similarly, humeral head cysts were not associated with upper arm elevation above 90°; the odds ratio for >= 20 months of exposure was 0.68)
- The 23 house painters had 15 cases of dominant side tendinopathy and also had 15 cases of tendinopathy on the nondominant side

- Duration of employment was not related to the duration of employment in trade; lifetime arm elevation also was not related to the duration of employment in trade
    - This lack of association was interpreted as having arisen from the eligibility criteria, which precluded any substantial variation in duration of employment
- Force (torque) was not associated with tendinopathy on MRI

Authors' conclusions:

- Arm elevation above 90° increased the frequency of supraspinatus tendinitis as seen on MRI, with a tendency toward higher grades of tendinopathy with increasing exposure
- The decrease in odds of A-C joint degeneration and humeral head cysts with increasing exposure is evidence of a healthy worker effect
- The equal presence of supraspinatus tendinopathy in the dominant and nondominant shoulders of the 23 house painters could be due to their ability to adjust their work habits and use the nondominant shoulder more often

Comments:

- Exposure to arm elevation for all subjects was based on direct measurement of a random sample of only 72 subjects
    - If the sample was truly random (method of random selection was not described), then there would be a slight tendency to underestimate the odds ratios for exposure and tendinopathy
- The lack of "statistical significance" in the workers with >=20 months of arm elevation was probably due to the smaller number of cases (n=19) in that exposure category compared to the cases in the entire sample (n= 52)
- There is no link to an original study protocol, and it is not clear that the five month interval for the calculation of the odds ratio for lifetime arm elevation was preplanned; one cannot rule out the possibility that the selection of that five month interval was made after the data were available, raising the possibility of a degree of "data mining"
- The outcome of interest was MRI tendinopathy, not symptomatic tendinopathy; many cases could have been subclinical
- The kappas for the reliability of the MRI appear to have been measured not between the two radiologists but between their readings of the same MRI five days apart
    - It is not stated that the radiologists worked independently, and may have conferred between themselves for the MRI readings
    - However, both were blinded to symptoms and exposure for the MRI of the nondominant shoulders
    - It is a bit surprising that the kappas for the two MRI readings five days apart were not higher than they were

- Overall, the evidence points to an increased frequency of supraspinatus tendinopathy with increasing arm elevation above 90 degrees
    - The 5 month exposure is difficult to translate into hours per day, but could represent an exposure comparable to that which was reported in Svendsen & Bonde 2004 on the same study population, of 6-9% of working time, or 30 minutes per day for a house painter at or above 90 degrees of elevation for 5 or more years

Assessment: Adequate for some evidence that jobs like that of a house painter, with arm elevation above 90 degrees for more than 30 minutes per day for five or more years, increased the odds of supraspinatus tendinopathy by 27% for each five years of exposure

Reference:

Svendsen SW, Bonde JP, et al. Work related shoulder disorders: quantitative exposure-response relations with reference to arm posture. Occup Environ Med 2004;61:844–853.