

**Physical activity, clinical examination, and the young spine: A two-year prospective cohort study with 1,300 Danish adolescents aged 11-13**

**Background and aims:** The severity and course of spinal pain (neck pain, mid back pain, low back pain) and its predictive factors are poorly understood in adolescents. Physical activity is thought to play a role, either as a risk factor or protective factor for spinal pain, but current evidence is conflicting. This thesis is based on five papers with the following aims: 1) to describe the severity and course of spinal pain; 2) to determine the extent to which different levels of physical activity were predictive of the incidence of spinal pain; 3) to determine the extent to which different levels of physical activity were predictive of the progression of spinal pain; 4) to determine the diagnostic and predictive values of commonly used clinical tests for current and future spinal pain respectively; and 5) to determine whether these tests were reliable.

**Methods:** A school-based two-year prospective cohort study involving 1,348 adolescents aged 11-13 years was conducted. Data were collected at baseline (2010) and again two years later and included e-survey, accelerometer assessments, physical fitness measurements, and a screening examination with commonly used clinical tests. Different levels of physical activity were used as exposure and different definitions of spinal pain were used as outcome. The models included potential confounders such as sex, anthropometry, physical fitness, psychological factors, and social status. For the clinical examination, different definitions of spinal pain were used as reference standard. The tests were investigated both individually and collectively. A reliability study was also conducted; data were collected at another school and involved 116 adolescents aged 12-14 years. Data collection included screening examinations with commonly used clinical tests (2012). Reliability- and measurement-error measures were calculated.

**Results:** *Paper 1:* The lifetime prevalence of spinal pain was 86% at baseline and 89% at follow-up. The proportion of participants who reported that they had pain frequently was 13.6% (95% confidence intervals (CI) 11.8-15.6) at baseline and 19.5% (95% CI 17.1-22.0) at follow-up. The frequency and intensity of spinal pain were strongly associated. *Paper 2:* Based on participants with no history of spinal pain at baseline, the 10% of participants with the highest proportion of the day spent in vigorous physical activity were at increased risk of developing spinal pain with a relative risk (RR) of 1.35 (95% CI 1.06-1.70) in the bivariate analysis and RR of 1.44 (95% CI 1.09-1.91) in the multivariable analysis. *Paper 3:* There were neither cross-sectional nor longitudinal associations between different levels of objectively measured physical activity and spinal pain. *Paper 4:* The sensitivity was low and the specificity was high for all included clinical tests. However, tests that included a pain response were associated with pain, whereas tests that only evaluated clinical

characteristics other than pain were not. When all tests were included in one model, the tests were quite good in detecting current pain with AUCs ranging from 0.60 to 0.81 depending on the disease definition. *Paper 5*: The reliability of the included tests varied widely from a Kappa value of 0.65 (95% CI 0.33-0.97) for scoring more than 4 on the Beighton scale to an ICC of 0.53 (95% CI 0.26-0.73) for the Schober's test.

**Conclusion:** Spinal pain was common at ages 11-15 years, but only a small group had frequent and intense pain. Physical activity was generally not associated with spinal pain, but vigorous physical activity increased the risk of new cases over a two-year period. The diagnostic value of commonly used clinical tests was poor. We think practitioners in clinics and schools should reconsider using these tests for the screening of spinal pain in adolescents aged 11-15 years, as no tests were predictive of future pain. Some clinical tests showed good, and some tests poor, reliability when applied in a spinal screening of adolescents. Future research should focus on the more qualitative aspects of physical activity, for example the association with different types of sports activities. Moreover, developing tools for diagnostic and screening purposes of spinal pain is warranted.