# Trunk muscle strength, morphology and movement coordination in participants with low-back pain and asymptomatic controls

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## Summary

We investigated lumbo-pelvic kinematics, trunk muscle strength and morphology in a large cohort of individuals with low-back pain (LBP) and asymptomatic controls and highlighted specific effects of sex and pain intensity. Our results indicate that the assessment of lumbo-pelvic kinematics during a trunk flexion has limited practicality in the clinical diagnosis and management of LBP. Further, it appears that both the variability and the local dynamic stability of trunk movement may not be sensitive enough to detect an association with LBP. The identified decrease in trunk extensor muscle strength in LBP patients with no concomitant alterations in muscle morphology indicate an influence of neuromuscular factors.

## Introduction

Trunk posture and lumbo-pelvic coordination can influence spinal loading and are commonly used as clinical measures in the diagnosis and management of LBP and injury risk. It has also been suggested that trunk muscle strength and morphology, as well as the motor control of trunk stability and trunk movement variability is altered in individuals with LBP, with possible implications for pain progression. Nevertheless, there is currently a lack of clear links between LBP and possible sex-specific characteristics. The aim of this study was to investigate lumbo-pelvic kinematics, trunk muscle strength and morphology in an adequately large cohort of individuals with LBP and asymptomatic controls and to explore specific effects of sex and pain intensity.

## Methods

We measured lumbo-pelvic kinematics during trunk flexion, trunk dynamic stability and movement variability during a cyclic pointing task, and trunk extension and flexion strength during isometric maximal voluntary contractions in 410 adults (210 females) aged between 18 - 64 years, reporting either no LBP or pain in the lumbar area of the trunk. In a subgroup (N = 185) of the included participants, magnetic resonance images of the lumbar spine were used to measure the anatomical cross-sectional area (aCSA) and fat area and calculate the respective functional cross-sectional area (fCSA) and fatty infiltration of the lumbar multifidus and erector spinae muscles. Participants were grouped based on their characteristic pain intensity as asymptomatic (N = 64), low to medium pain (N = 258) or medium to high pain (N = 81). Data were analyzed using linear mixed models in the style of a two way anova.

## Results and Discussion

Female participants showed a higher ($p<0.05$) range of motion in both the trunk and pelvis during trunk flexion, as well as an increased ($p<0.05$) lumbar lordosis throughout the entire trunk flexion movement. Further, female participants showed less muscle strength in both trunk extension and flexion as well as a smaller aCSA and fCSA and larger fat area and fatty infiltration of the erector spinae and lumbar multifidus muscles (all $p<0.05$). The intensity of pain had a negligible effect on trunk posture and the lumbo-pelvic coordination. No effects of sex or pain intensity ($p>0.05$) were detected in trunk dynamic stability and movement variability. Both female and male participants with LBP showed a decrease in maximum trunk extensor strength ($p<0.05$). On the other hand, aCSA and fatty infiltration of the erector spinae and multifidus muscles did not differ between asymptomatic and LBP participants ($p>0.05$).

## Conclusions

Our findings indicate that clinical diagnostic variables such as lumbo-pelvic coordination, trunk kinematic variability and trunk local dynamic stability may not be sensitive enough to detect an association with LBP. In participants with LBP, we found a reduction in the strength of the trunk extensor muscles, but this reduction was not associated with a degeneration in muscle morphology. The decrease in strength of the trunk extensors despite non-significant alterations in aCSA and fatty infiltration of the trunk muscles strongly suggests neuromuscular changes associated with LBP.

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