THE INFLUENCE OF SURFACE FRICTION ON LOW-BACK MOMENTS DURING MANUAL LIFTING

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SUMMARY
This study investigated the effect of surface friction on peak L5/S1 extension moments in eleven male subjects. The peak L5/S1 extension moment was estimated by using a bottom-up inverse dynamics model. The effect of surface friction was studied in a realistic lifting task in which the subjects lifted boxes from 3 initial horizontal positions (close, middle and far position from the body) from floor level and from a table.
Significant effects of surface friction were found for the lifts from the middle and far initial horizontal positions from the table. No effects of surface friction were found for the lifts from floor level.

INTRODUCTION
Manual lifting can result in high low-back loading [1] which is probably the main reason why it is also an important risk factor for occupational low-back pain [2]. A high surface friction can probably contribute to a high low-back loading, especially in situations where the loads have to be lifted from a large initial horizontal distance with respect to the body. This study investigated the effect of surface friction on low-back loading (L5/S1 moments) in lifts from floor level and in lifts from a table.

METHODS
Eleven healthy male participants lifted 16.8kg boxes with handles from a low-friction surface (smooth plastic coated surface) and from a high-friction surface (anti-slip, Dycem Ltd., Bristol, United Kingdom) at two heights: floor level (handle height 27cm) and 80cm table (handle height 107cm) (Figure 1). Furthermore, boxes were lifted from three initial horizontal distances: 17.5cm (close), 37.5cm (middle) and 57.5cm (far) from the edge of the surface to the handles of the box. To make the task more realistic, subjects had to lift the box, turn around and place it on a table outside the measurement area. Prior to the experimental lifting task, subjects underwent a short training, familiarizing them with alternative lifting strategies that they could use [3].
Ground reaction forces, body segment anthropometrics and kinematics were measured and peak extension L5/S1 moments were calculated using a bottom-up 3D inverse dynamics model [4]. Bonferroni corrected student t-tests were used to test the effects of surface friction on the peak L5/S1 extension moment.

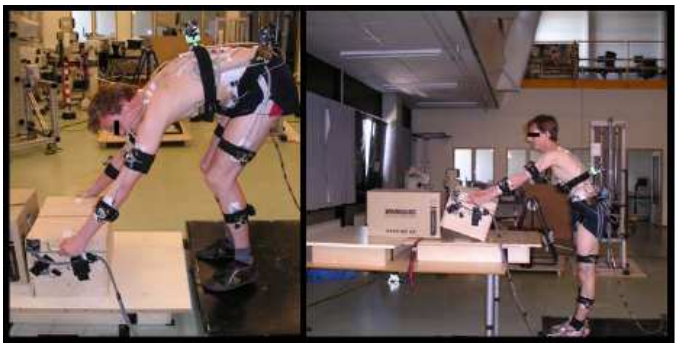

Figure 1: Subjects lifting the box from floor level and from a table (from far initial horizontal positions)

RESULTS AND DISCUSSION
Figure 3 shows the effect of surface friction on the peak L5/S1 extension moment for all experimental conditions. Peak L5/S1 extensions were significantly higher in the high-friction condition for the lifts from the middle and far initial horizontal positions from the table.

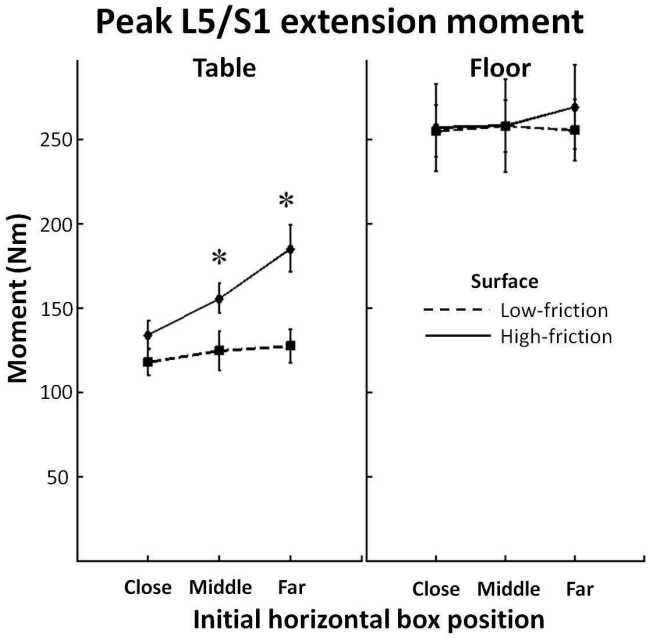

Figure 2: Effect of surface friction on Peak L5/S1 extension moments. * indicates significant effect of surface-friction.

For lifts from floor level no effect of surface-friction was found. The main reason for this was that, when lifting from a low-friction surface at floor level instead of from the table, the distance that subjects did slide the box over towards the body prior to lifting was smaller.

CONCLUSIONS

It was found that increased surface friction does lead to an increase in low-back moments when lifting from a table but not when lifting from floor level.

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