RAPID RESEARCH

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Squat Mechanics and Spinal Loads

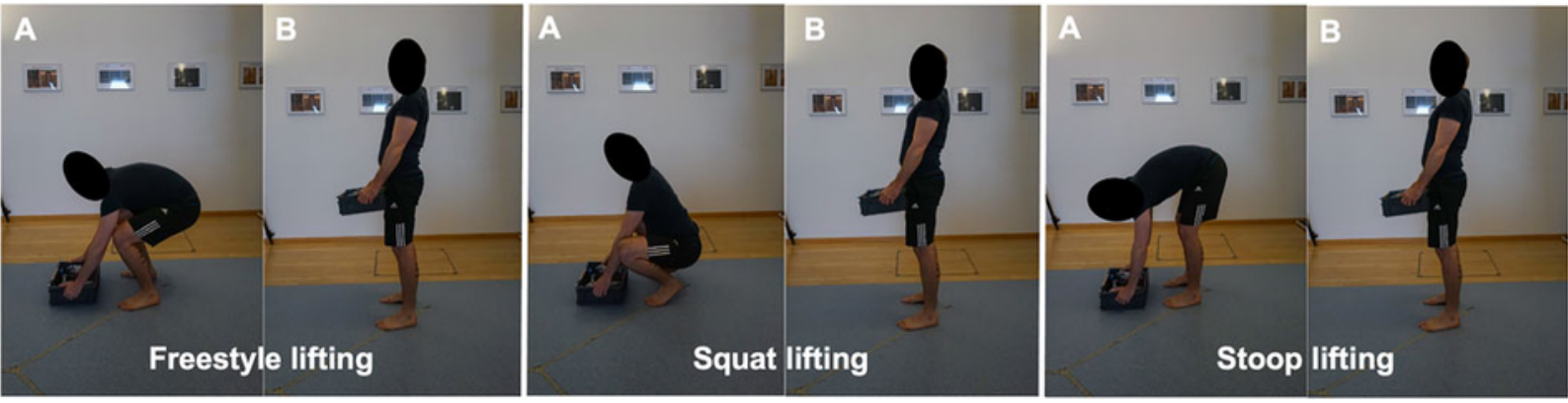
- Lumbar Loading In Different Lifting Styles
- The Stoop-Squat Index
- Lumbar Curve and Lifting Kinematics

LUMBAR LOADING IN DIFFERENT LIFTING STYLES

OCTOBER 2023

Click for Full Text (Von Arx et al. 2021)

This study compared lumbar loads among different lifting styles using a comprehensive state-of-the-art motion capture-driven musculoskeletal modeling approach.



KEY FINDINGS

30 healthy individuals repetitively lifted a 15 kg-box using 1) Freestyle, 2) Squat, 3) Stoop lifting technique.

Continuous & Peak compressive, anterior-posterior shear & total loads (were calculated and expressed as factor body weight (BW).

Results:

Stoop lifting showed significantly lower compressive & total loads (-0.3 to -1.0BW) vs. freestyle and squat lifting.

Stoop lifting produced higher shear loads (+0.1 to +0.8BW) in the segments T12/L1 to L4/L5, but lower loads in L5/S1 (-0.2 to -0.4BW).

Lumbar Lordosis Range of Motion:

Stoop lifting (35.9 ± 10.1°)
Freestyle (24.2 ± 7.3°)
Squat (25.1 ± 8.2°)

MAIN TAKEAWAYS

Stoop lifting produced lower total and compressive lumbar loads than squat lifting.

Shear loads were generally higher during stoop lifting, except for the L5/S1 segment, where anterior shear loads were higher during squat lifting.

While loads consistently increased towards the lower end of the spine, differences in spinal loading between lifting styles were more pronounced in the upper part of the lumbar spine.

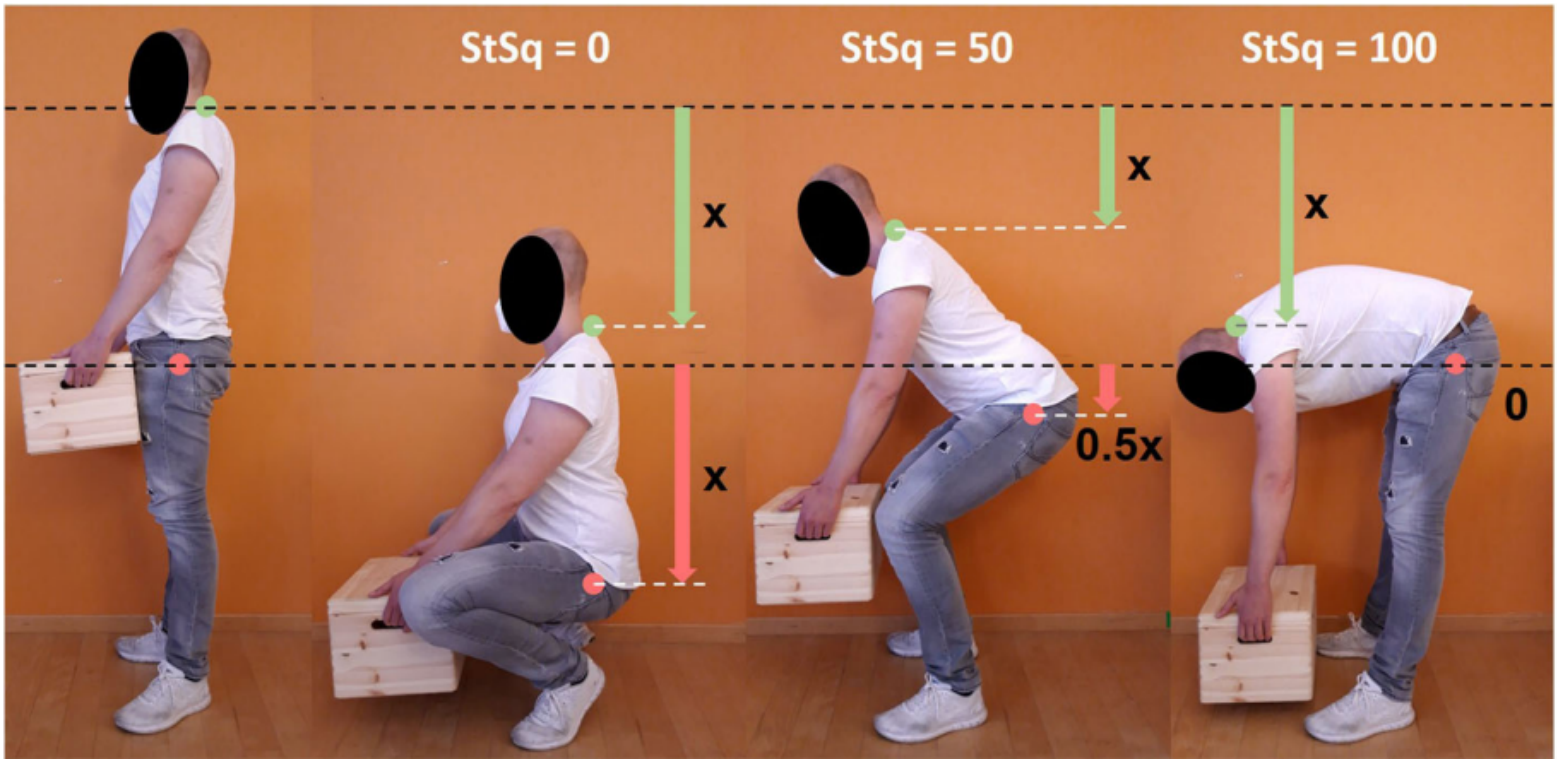
The clearly noticeable lumbar spinal flexion occurring during squat lifting suggests that the spine never stays fully neutral during lifting, even when specifically asked to not flex the spine.

THE STOOP SQUAT INDEX

OCTOBER 2023

Click for Full Text (Schmid et al. 2022)

This research developed a novel index for quantifying the stoop-squat behavior, and to establish normative values of the index for healthy pain-free adults



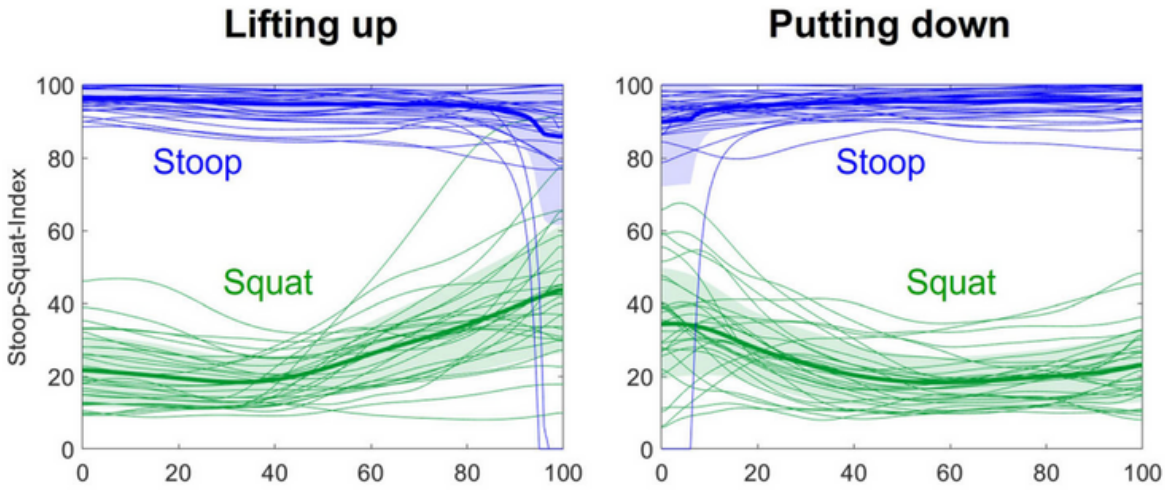
KEY FINDINGS

Stoop-Squat-Index:

Proportion between trunk forward lean and lower extremity joint flexion

- 0; full squat (SQ) to 100; Full stoop (ST).
- Normative values established in 30 individuals via motion analysis of SQ & ST

Average index values <30 & >90 for SQ & ST movements, respectively, differed significantly from each other for the full duration of the lifting phases.



MAIN TAKEAWAYS

The proposed index represents a novel and powerful measure for evaluating stoop-squat behavior during object lifting, which can fairly easily be derived from conventional video recordings with an expected high accuracy.

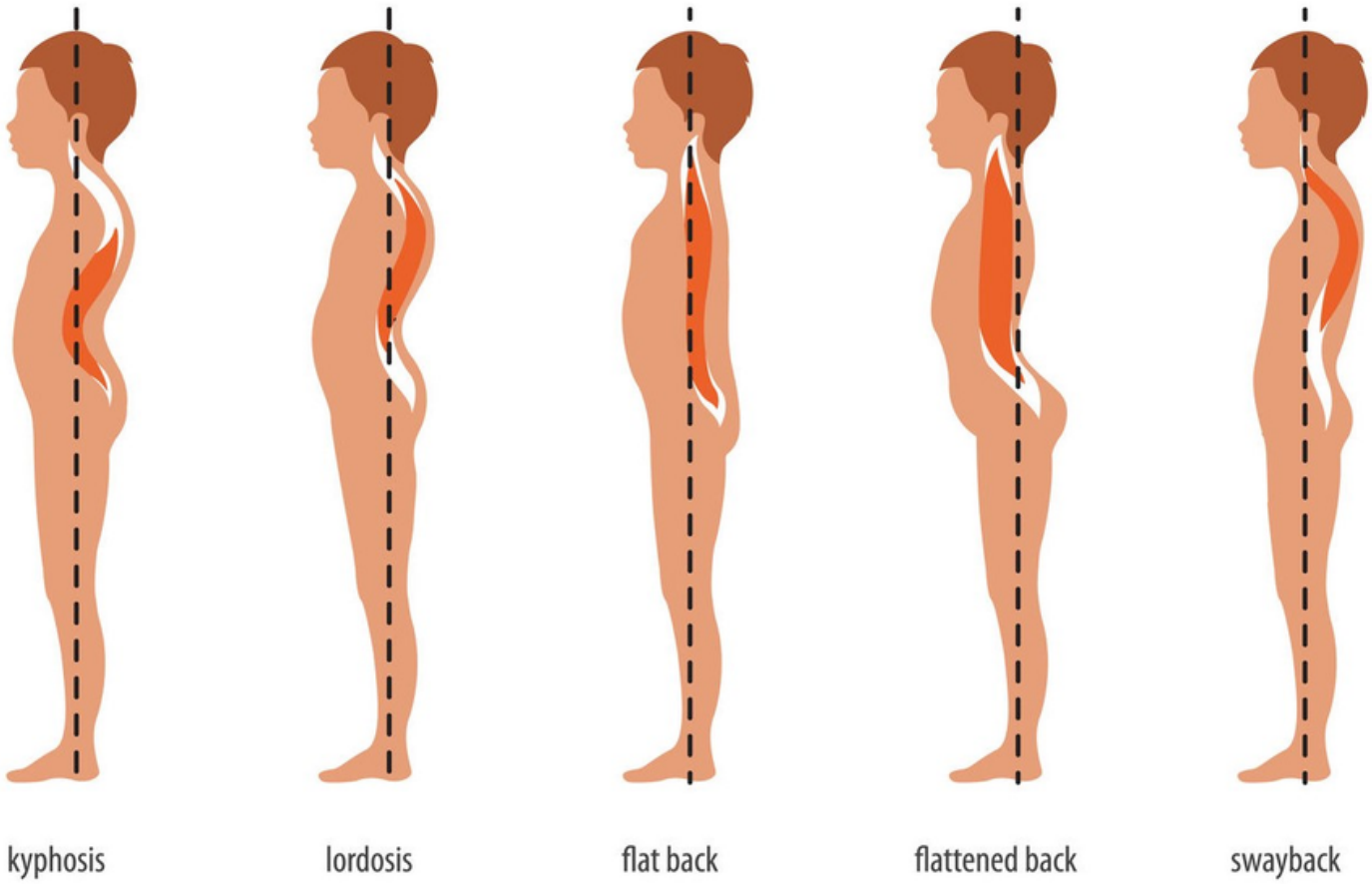
When used in combination with lumbar spine flexion measurements, the index can contribute important information, which is necessary for comprehensively evaluating whole-body object lifting strategies.

LUMBAR CURVE AND LIFTING KINEMATICS

OCTOBER 2023

Click for Full Text (Pavlova et al. 2018)

This study described the etiological and epidemiological characteristics of patients with surgically treated radial nerve lesions of various origins.



KEY FINDINGS

30 healthy adults performed freestyle, stoop and squat lifts with a weighted box while being recorded by Vicon motion capture.
- Internal spine shape was characterized using statistical shape modeling (SSM) from standing mid-sagittal MRIs.

Findings:
Mode1 (M1) 55% variance; Greater peak pelvis & smaller knee flexion angles.
Mode2 (M2) 12% variance;

No associations between peak flexion angles and mode scores in stoop or squat trials.

Peak flexion angles were positively correlated between freestyle and squat trials but not between freestyle and stoop or squat and stoop, indicating that individuals adjusted knee flexion while maintaining their preferred range of lumbar flexion.

MAIN TAKEAWAYS

The natural shape of the lumbar spine in standing, how lordotic it is, was associated with an individual's preference to squat or to stoop to lift a weight from the floor.

Individuals with curvier spines preferred to stoop, and those with straighter spines preferred to squat in freestyle lifts.

Natural 'squatters' adapted more easily to stooping than natural 'stoopers' to squatting.

Lifting styles tailored to each individual may be important to avoid potentially damaging manoeuvres.

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