

## Introduction

Lifting training videos and images posted by official resources do not suggest postures that potentially harm the end users however unregulated sources from the internet may recommend lifting videos and pictures which may harm the end user as they lack proper instruction and cannot give feedback to workers learning the lifting methods. There are numerous financial resources dedicated for training workers in order to reduce the MSD injuries and yet musculoskeletal disorders are still the most common type of injuries in Ontario workplaces. There has been a shift to e-learning and online training. According to WSIB low back pain from overexertion accounts for over 20% of high impact injury claims.

## Objective

To determine the lifting methods available to workers through the internet.

To compare an established lifting method, the squat lift, to one suggested by several internet sources, the kneeling lift.

## Methodology

The study consisted of 61 videos or pictures from a variety of sources (30 pictures and 31 videos). The videos were analyzed by determining the critical lifting point and taking a screenshot which was then uploaded into 3DSSPP. The analysis for the pictures was much simpler as they were static and had a predetermined critical lift point. 3DSSPP was used to analyze videos at the point of lifting and lowering. Lifting postures included: squat, deep squat, stoop, power lift, lunge lift, half kneeling lift, golfer's lift, and tripod lift. This study will focus on the squat and kneeling lift methods, which are common training methods on most websites. 10 different squat and kneeling lift methods were analyzed by determining the critical lift point and modeled in 3DSSPP and 3D joint moments were extracted for comparison. Seven kneeling lift methods were analyzed. The critical point of the kneeling lift method was split up into 2 stages. The first stage is when the lifting leg is flexed at 90 degrees and the lower leg is held vertical to the ground. The lifting foot is held flat on the ground ready to carry the whole body weight when the other leg is flying in the stage 2. The kneeling leg in stage 1 is flexed at 90 degrees, but is held against the floor (Figure 1). In this stage almost 80% of the body weight is on the knee cap, which was not evaluated in this study. Only the lifting knee at the stage 2 was evaluated, where the whole body weight is on the lifting leg. This posture of the body puts asymmetrical loads on the lifting hip, knee, and the ankle in comparison to other types of lifting where both feet are flat on the ground the lifting is conducted symmetrically.

The 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile were extracted in 3DSSPP for both squat and kneeling lift methods to give a better representation of the population as the anthropometrical variables were not available in either the pictures or the videos that were extracted from the websites and other resources.

## Kneeling Lift

### Stage 1



Figure 1- Kneeling reaction force is potentially 80% of the body weight

### Stage 2



Figure 2- Lateral moment of the Lifting Knee in stage 2

Stage 1- Stable posture with a significant amount of body weight on the knee cap.  
Stage 2- Body weight shifts to the lifting hip, knee, and ankle.

## Discussion

The squat lift is a stable, balanced, symmetrical lift which keeps the object close to the body and relies on having a straight back and bent knees while lifting. The squat lift method is part of the NIOSH Ergonomic Guidelines for Manual Material Handling. The kneeling lift is made up of 2 stages. The first stage requires the person to kneel on one knee (Figure 1). At stage 1 this lifting method is stable, the back is straight and the load being lifted is close to the body. However, during this stage there is a significant amount of force being applied to the knee cap as most of the body weight is resting on it (Figure 1). The force being applied to the knee cap makes this lifting method unsuitable for any terrain that is less than ideal such as wet, rough, or icy terrain.

In stage 2 of the kneeling lift, the body and the load weight is on one leg asymmetrically. The "lifting leg" joints including hip, knee, and ankle are all undergoing flexion and lateral moments in comparison to the squat lift. As shown in Figure 3 and 4, the lumbar spine flexion moment in kneeling lift is less than applied flexion moment in squat. However, the ankle and the knee flexion moment of the lifting leg in kneeling method is 2-3 times larger than the applied moment to the same joints in squat lift.

The knee is not designed for lateral movement and performing the kneeling lift method may cause knee instability. Older workers or workers with compromised knees could be at a higher risk for an injury if they perform this lift.

Kneeling lift is one of the common training lift by chiropractors, physiotherapists, manual material handling trainers, and lift method training websites due to its efficiency by lifting the load from the floor level to the knee level at the stage 1 lifting. It also applies lower moments to the lumbar spine in this posture. Researchers and trainers propose this lifting methods for people who have severe back injuries and they understand that they are sacrificing the other joints to improve their mobility during the injury. However, kneeling lift should be avoided in repetitive lifting tasks and for regular individuals.

## Results

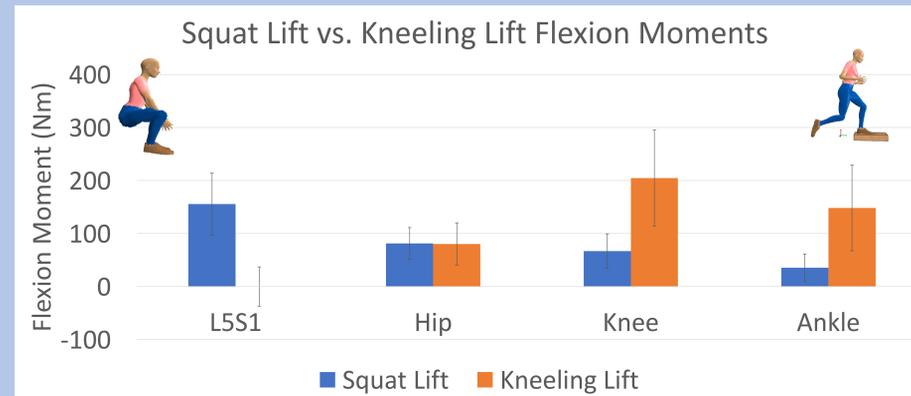


Figure 3- Graph of the mean joint moments in the x direction for squat lift and kneeling lift

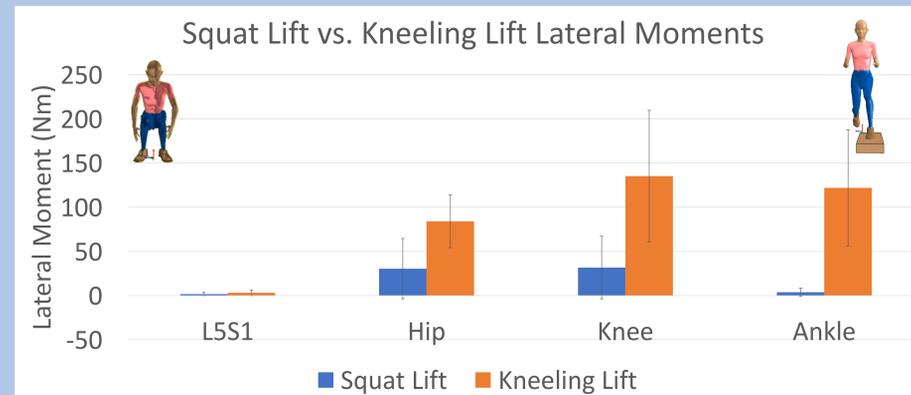


Figure 4- Graph of the mean joint moments in the y direction for squat lift and kneeling lift

## Conclusion

In conclusion, not all of the recommended lifting training videos and images posted on the web or even published in the reference books can be trusted. More trustworthy training videos designed and created under the supervision of the researchers should be provided and these lifting methods should be taught by a competent person taking into account the abilities of the person performing the lift. This study is part of a bigger study and further solid results will be published soon.