Comparison of Shoulder Joint Motion and Kinetics During Fast and Inclined Reverse and Conventional Manual Wheelchair Propulsion

L. Lighthall Haubert, P. Requejo, S. Mulroy, S. Maneekobkunwong, D. Rodriguez, J. Gronley
Pathokinesiology Lab, Rancho Los Amigos National Rehabilitation Center, Downey, CA

OBJECTIVE
Shoulder pain after spinal cord injury (SCI) is highly prevalent, impacting up to 70% of individuals. Rotator cuff tendinopathy, the most common cause of shoulder pain after SCI, has been attributed to a shift in the weight-bearing demands of functional mobility to the upper limbs. The superior and posterior forces imposed on the shoulders during manual wheelchair (WC) propulsion are thought to be substantial contributors. Reverse WC propulsion (pulling back vs. pushing forward) could potentially alter these detrimental demands, especially under higher demand propulsion (eg. fast & inclined).

Purpose:
- Compare matched fast & inclined (8%) reverse & standard manual WC propulsion characteristics & GH joint motion & forces

Hypotheses:
- Similar propulsion characteristics & peak gleno-humeral (GH) joint motion
- GH Joint A/P Forces reversed during reverse propulsion

DESIGN/METHODS
Participants: Convenience Sample of 10 Males
- Paraplegia (AIS A, B, C) - SCI > 1 Year
- Manual WC Users - Without Shoulder Pain (WUSP) < 12

Matched Fast & Graded Propulsion (3 conditions):
- Fast: Kinaesthetic Perception & Kinetics
- Forward Propulsion (fSW)
- Reverse Propulsion (rSW)
- Right Wheel & Upper Limb & Trunk Motion (Qualysis)
- Pushrim Kinetics & Inverse Dynamics (rSW, fSW only)
- SPSS 22.0 Software

RESULTS
Participants:
Mean Age: 40 years (30-53)  Mean DOI: 15 years (2-28)

Peak Shoulder Extension (at backward hand position) was significantly less in Reverse Fast & Inclined (RW & rSW) vs. Forward Propulsion (fSW) by 10-25 deg.

Peak Shoulder Abduction (at forward hand position) was significantly greater (5 deg) in Reverse Fast (RW & rSW) vs. Forward Propulsion but may not be clinically signficant.

CONCLUSION
The significant reduction in posterior (fast/inclined) & superior (inclined) shoulder forces during reverse propulsion in these high-demand conditions may protect subacromial structures from impingement to prevent injury/pain & preserve mobility, independence, & participation for individuals with paraplegia.

Shoulder muscle activity in such conditions must be analyzed.

ACKNOWLEDGEMENT
This work was supported by RoWheels®. The funding source had no input into study design nor data collection, analysis or interpretation; manuscript writing; nor decision to present.