

Manual wheelchair users gradually face fewer challenges in postural stability and control with increasing rolling resistance while maintaining a **rear-wheel wheelie**

Mathieu Lalumière ^{a,b}, Guillaume Desroches ^{a,b}, Philippe Gourdou ^b,
François Routhier ^{c,d}, Laurent Bouyer ^{c,d}, Dany H. Gagnon ^{a,b}

^a School of Rehabilitation, Université de Montréal, Montreal, Canada

^b Pathokinesiology Laboratory, Centre for Interdisciplinary Research in Rehabilitation (CRIR), Montreal, Canada

^c Department of Rehabilitation, Université Laval, Quebec City, Canada

^d Centre for Interdisciplinary Research in Rehabilitation and Social Integration (CIRRIS), Quebec City, Canada



BACKGROUND

Teaching manual wheelchair users to perform and maintain **wheelchair wheelies** over surfaces of progressively decreasing rolling resistances is expected to facilitate the acquisition of this advanced wheelchair skill in clinical practice. However, limited scientific evidence supports this clinical approach.

PURPOSE

To compare postural stability and control requirements when maintaining a stationary wheelie on surfaces having different rolling resistances.

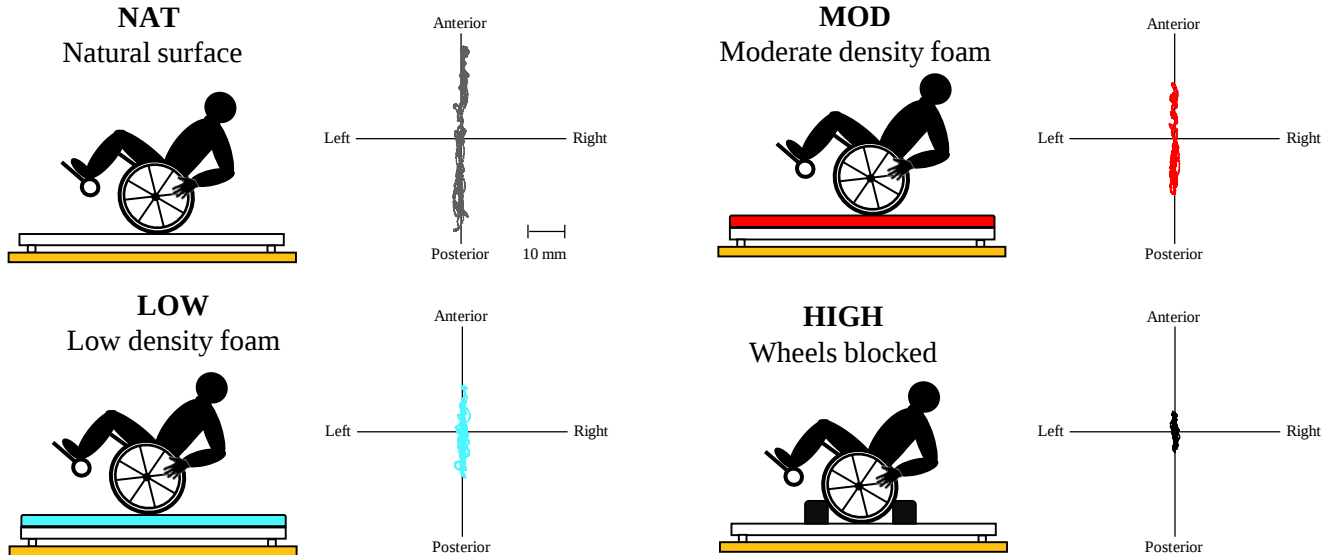
This study will provide the first evidence to confirm or not the relevance of this clinical approach by physiotherapists to facilitate skill acquisition.



METHODS

Eighteen manual wheelchair users with a spinal cord injury randomly performed and maintained four 30-second wheelies on four different rolling resistances: natural hard floor, **low-density foam**, **moderate-density foam**, and rear wheels blocked by wooden blocks.

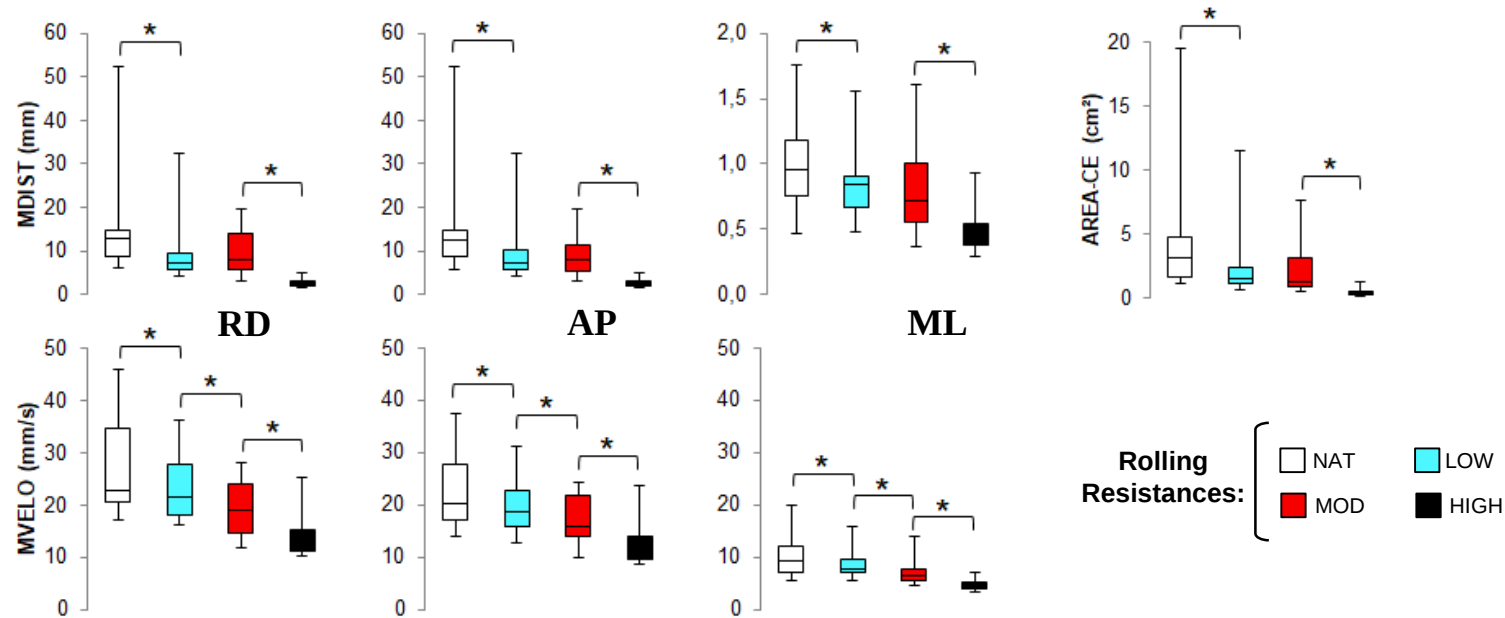
A large instrumented force plate was used to continuously record the center of pressure (CoP). To quantify postural stability, time- and frequency-domain center of pressure measures were computed in the horizontal plane for the resultant distance (RD), and then fragmented into anteroposterior (AP) and mediolateral (ML) directional components.



RESULTS

Time-domain measures were the mean distance from the mean CoP (MDIST), mean velocity of the total CoP trajectory length per trial duration (MVELO) and the area of an ellipse enclosing 95% of all CoP data points (AREA-CE; cm²).

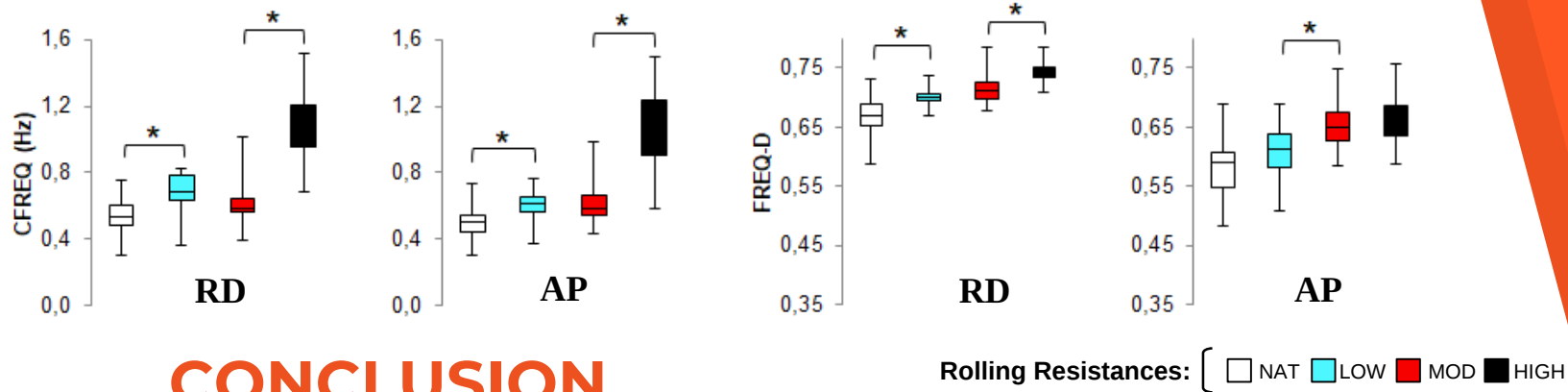
All resultant time-domain measures confirmed increased postural stability from NAT to LOW and from MOD to HIGH rolling resistances. Most time-domain measures confirmed a shift in postural control from an anticipatory to a predominantly reactive strategy, especially from NAT to LOW and from MOD to HIGH rolling resistances.



RESULTS

Frequency-domain measures were the centroidal frequency (CFREQ), the frequency at which the spectral mass is concentrated) and the frequency dispersion (FREQ-D), the variability in the frequency content of the power spectral density

CFREQ significantly increased in terms of RD and the AP directional component values between the NAT vs LOW and MOD vs HIGH conditions. FREQ-D also significantly increased in terms of RD values between NAT vs LOW and MOD vs HIGH conditions, and AP directional component values between LOW vs MOD conditions.



CONCLUSION

Blocking the rear wheels is recommended when physiotherapists first teach this advanced wheelchair skill to manual wheelchair users. **Rapid progression on foam** and natural surfaces is advocated to refine learning and enhance proper postural control strategies.