# Seat and footrest shocks and vibrations in manual wheelchairs with and without suspension☆

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## Abstract

Cooper RA, Wolf E, Fitzgerald SG, Boninger ML, Ulerich R, Ammer WA. Seat and footrest shocks and vibrations in manual wheelchairs with and without suspension. Arch Phys Med Rehabil 2003;84:96-102.**Objective:** To examine differences in the shock and vibration transmitted to an occupant of a manual wheelchair with and without suspension caster forks and with and without rear-suspension systems. **Design:**Repeated-measures engineering testing. **Setting:** Rehabilitation engineering center with a wheelchair standards test laboratory. **Specimens:** Six manual wheelchairs. **Interventions:** An American National Standards Institute/Rehabilitation Engineering and Assistive Technology Society of North America wheelchair test dummy and a Hybrid III test dummy were used to test shock and vibration transmission in wheelchairs equipped with original equipment manufacturer (OEM) caster forks and suspension caster forks. Ultralight wheelchairs, half of which had factory-equipped rear-suspension systems, were tested. Testing was conducted on a double-drum wheelchair test machine. **Main Outcome Measures:** Shocks were examined by using peak acceleration and the frequency at which peak acceleration occurs for the seat and footrest. Vibration was characterized by the acceleration power per octave for the seat and footrest. **Results:** Significant differences were found in the peak accelerations at the seat (*P*=.0004) and footrest (*P*=.0007) between the wheelchairs with the OEM caster forks and those with the suspension casters. The wheelchairs with suspension had significantly different frequencies at which the peak accelerations occurred for both the seat (*P*=.01) and footrest (*P*=.0001). The wheelchairs with suspension caster forks had a lower total power per octave than the wheelchairs with the OEM caster forks. For the footrest vibrations, significant differences were found between the types of caster forks for all octaves except those associated with frequencies more than 78.75Hz. There were significant differences for wheelchairs with and without rear suspension for total power per octave of seat vibrations in the octaves between 7.81 and 9.84Hz (*P*=.01) and 12.40 and 15.63Hz (*P*=.008). **Conclusions:** Suspension caster forks reduce the shock and vibration exposure to the user of a manual wheelchair. Rear-suspension systems reduce some of the factors related to shock and vibration exposure, but they are not clearly superior to traditional designs. *[copy ] 2003 by the American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation* .