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ORIGINAL ARTICLE

One Size Does Not Fit All—Mobility Device Type Affects Speed, Collisions, Fatigue, and Pain

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Abstract

Objective: To determine whether differences could be detected in mobility outcomes during community mobility and home mobility tasks according to type of mobility assistive device.

Design: Randomized, repeated measures.

Setting: Community mobility task: traversing 341.4m between the rehabilitation clinic and hospital entrance; home mobility task: traversing 39m into and out of a patient training bathroom and bedroom.

Participants: Community-dwelling, cognitively intact ambulatory veterans (N=59) who used a mobility device within the 14 days prior to the study.

Interventions: Participants tested 3 types of mobility assistive devices with wheels: 4-wheeled walker (WW), manual wheelchair (MWC), and powered wheelchair (PWC). The first and last devices used by each participant were randomly assigned as either MWC or WW. The PWC was always the second device.

Main Outcomes Measures: Speed (m/s), collisions (total), fatigue (0−10 Likert scale), and pain (0−10 Likert scale, diagram).

Results: The community mobility task was performed with all 3 devices by 52 (88%) veterans, and the home mobility task was performed with all 3 devices by 53 (90%) participants. In each task, 28 participants used the WW and 28 participants used the MWC as the final device. In the community mobility task, statistically significant differences ($P<.05$) were seen with ≥1 device comparison for all studied outcomes (eg, standardized mean difference for the MWC compared with the PWC showed −.67 fewer collisions for the MWC). In the home mobility task, speed, collisions, and fatigue showed statistically significant ($P<.05$) device-related differences (eg, standardized mean difference for the WW compared with the MWC showed −.88 fewer collisions for the WW).

Conclusions: We found statistically significant and substantively different effects from 3 commonly used mobility assistive devices with wheels on diverse mobility outcomes when used in typical community mobility and home mobility tasks, providing proof of concept support for a research methodology applicable to comparative outcome studies of diverse mobility aids.

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There has been rapid expansion in the diversity of mobility aids.[1] Use of mobility aids is no longer limited to frail, sick, older adult patients in institutional settings.[2] These changes have far outpaced research to help inform policy and practices for the provision of mobility aids relative to the complex interface of the user's abilities, device attributes, and particular mobility tasks.[3-5] Systematic reviews on outcomes research for diverse mobility aids report concerns over both the quantity and quality of the research.[6-8] In turn, this contributes to policy limitations on device prescription.

The lack of evidence about the merits of differing devices may contribute to variation in the provision of mobility devices.[2,3,9,10] It also may underlie the limited provision of potentially helpful

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mobility aids to disabled Medicare beneficiaries[11] and the provision of devices that do not optimally meet mobility needs[12,13]; this in turn potentially causes both device abandonment[14-16] and accidents with mobility aids.[17-19]

The lack of evidence on the relative merits of differing mobility devices is particularly challenging for persons who walk with difficulty. Partially ambulatory persons are the most common group prescribed mobility assistive devices.[2,20] For such persons, the need for mobility support relates to limited endurance from pain, fatigue, and/or shortness of breath. Multiple types of mobility aids may meet their mobility needs.

For persons who can walk some of the time, and whose primary mobility problem is one of endurance rather than balance or coordination, there are multiple devices to choose from. These devices include various canes, walkers, manual wheelchairs (MWCs), and power mobility devices. For any mobility device with wheels (eg, wheeled walker [WW], MWC, powered wheelchair [PWC]), device selection is compounded by the potential impact of environmental factors (eg, steps, uneven terrain). Clinical decision-making is further complicated by differential physical requirements depending on how the device is propelled (ie, via legs, arms, or motor). The multiple types of devices that may be prescribed and the multiple factors that potentially impact mobility outcomes make comparative research on mobility assistive devices particularly challenging. Our goal was to provide proof of concept support for a methodologic approach for comparative outcomes research on mobility assistive devices.

Therefore, we designed a study to investigate if we could detect statistically significant and clinically relevant differences in outcomes among partially ambulatory persons using 3 distinct mobility devices with wheels. Each device is propelled by 1 of 3 distinct methods, when used in natural surroundings. Our specific research questions were as follows: Do mobility outcomes differ according to the type of mobility device when used in a typical community mobility task and a home mobility task? What is the sensitivity of particular outcome measures for detecting differences in outcomes according to device type?

Methods

Conceptual underpinnings

We adapted the human activity assistive technology model[21] to indicate that the device, person, and environment all might affect task outcomes relative to a particular activity. We conceptualized outcomes (1) to measure organ system and activity outcomes per the World Health Organization's *International Classification of Functioning, Disability and Health*[22]; (2) to include subjective and objective measures; and (3) to include outcomes pertaining to distinct aspects of the person-device-environment interface.

For the independent variable of interest, we focused on device propulsion because of its relation to device costs[2] and its potential to differentially affect clinical outcomes. To isolate the effect of device propulsion, we studied 3 mobility aids. All devices had wheels, had similar dimensions (ie, device footprint), and provided seating. However, all of the devices are customarily propelled in 3 different ways (legs, arms, motor). The devices were used within 2 natural environments that differed substantively in the 2 factors we deemed most likely to interact with propulsion method to affect clinical outcomes (distance, path conformation).

List of abbreviations:

MWC manual wheelchair
PWC powered wheelchair
SMD standardized mean difference
WW wheeled walker

Study design

This study was a randomized repeated-measures design, with randomization of the MWC and WW. The PWC was always the second device used.

Participants

We reviewed the medical records of all persons treated at the Durham Veterans Administration Medical Center between July 2009 and October 2010 who were prescribed a mobility aid. Inclusion and exclusion criteria were used to ensure that all participants both needed a mobility device and could safely use all 3 devices without substantive customization. Inclusion criteria included the following: medical record showing that a mobility aid had been provided to the individual in the prior 3 to 12 months. Exclusion criteria included the following: (1) medical record showing a neurologic or cognitive disorder, poorly controlled hypertension, an unstable cardiac condition, major surgery in the prior 6 months, weight >136.4kg, or height >1.8m; (2) self-report showing that the veteran had not used a mobility aid in the prior 2 weeks, did not have an active driver's license, or had used a prescribed power mobility aid or needed human help to walk across a small room, transfer, or propel a wheelchair; or (3) performance testing showing an inability to walk 15.2m independently.

During the enrollment period, 1313 veterans were prescribed a mobility device. Persons who met the inclusion criteria and who were not excluded per the first exclusion criteria were sent a letter indicating they might be eligible for the study and to contact us if they were interested in participating. Among the respondents (n=329), a telephone interview was used to determine the second exclusion criteria. Performance testing was used to verify the third exclusion criteria. Of the respondents, 58 met all of the eligibility criteria and agreed to participate. Participants were retained in the study sample if they had complete data for all devices, on either mobility task (n=53, 91%) (fig 1).

Intervention: use of 3 different mobility devices in 2 defined mobility tasks

The devices were a WW (Eco Wide DX[a]; footprint: 63.4×119.4cm during use and including user's feet), a MWC (Sunrise/Quickie 2[b]; footprint: 63.5×111.8m), and a PWC (Invacare Pronto M91/SureStep[c]; footprint: 66.0×106.7cm). Customization of the device to the participant's body size was limited to height adjustment using interchangeable seat cushions and changing the length of the MWC footrest, MWC armrest, and/or WW posts. To ensure safe use in a hospital environment, the maximum speed for the PWC was set at 1.08m/s.

The community mobility task required traveling round trip between the rehabilitation clinic and the hospital entrance adjacent to handicap parking. The trip length was 341.4m long and included traveling through hallways, automatic doors, an elevator, and an outdoor patio stone walkway. The trip included 16 turns of ≥90°. The home mobility task required traveling to and from a