Accuracy of Activity Monitors for Measuring Walking Activity in Ambulatory Children with Cerebral Palsy

Debra A. Sala, MS, PT; Helyn E. Grissom, BS; Edward DelSole, MD; Mary Lynn Chu, MD; David H. Godfried, MD; Mara S. Karamitopoulos, MD; Surjya Bhattacharyya, MS; Alice Chu, MD

OBJECTIVE
To assess the accuracy of commercially available activity monitors, placed either on the waist or the wrist, to track steps and distance during ambulation for children with cerebral palsy in a controlled setting

METHODS
• Each participant was outfitted with:
  • Waist-based tracker (Fig.1)
  • Wrist-based tracker (Fig.2)
• Ambulated at self-selected speed for 670 feet in a hallway
• Gross Motor Function Classification System (GMFCS) score: I-III
• Individuals’ typical orthoses and assistive devices were used
• Number of steps and distance recorded on both devices
• Researcher simultaneously counted steps manually with tally counter

RESULTS
• 39 Participants with cerebral palsy:
  • Hemiplegia: 15 patients (38%)
  • Diplegia: 23 patients (59%)
  • Quadriplegia: 1 patient (3%)
• Mean age: 9.6 years (range, 4-15)
• Gender
  • Male: 23 patients (59%)
  • Female: 16 patients (41%)
• GMFCS Score:
  • I: 22 patients (56%)
  • II: 5 patients (13%)
  • III: 12 patients (31%)
• Orthoses:
  • No orthoses: 18 patients (46%)
  • AFOs: 19 patients (48%)
  • KAFOs: 1 patient (3%)
• Assistive Device
  • No device: 28 patients (72%)
  • Lofstrand crutches: 4 patients (10%)
  • Posterior rollator: 7 patients (18%)
• Mean speed: 2.1 mph (range, 0.7-3.3)
• Slowest walking subject was removed from remaining analysis because speed was 2.5 SDs below mean

RESULTS (Cont’d)
• Pearson Correlation Coefficients:
  • For number of steps:
    • Waist-based tracker and manual count: strong positive correlation; r = .991 (Fig. 3)
    • Wrist-based tracker and manual count: weak negative correlation; r = -.033 (Fig. 4)
• Mean absolute percent error:
  • For number of steps:
    • Waist-based and manual count: 2%
    • Wrist-based and manual count: 19%
  • For distance:
    • Waist-based and manual count: 56%
    • Wrist-based and manual count: 44%

CONCLUSIONS
• Waist-based tracker provided accurate step count. Neither waist-based nor wrist-based was accurate for distance measurement.
• Walking ability of ambulatory children with cerebral palsy can be accurately quantified with a readily available inexpensive activity tracker.
• Use of this tracker will enable clinicians to assess the effects of various treatments on the real-world activity level of this population.