

# Accuracy of Pedometer Steps and Time for Youth with Developmental Disabilities During Dynamic Movements

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**Abstract.** Pedometers are a valid measure of walking behaviors of youth with and without disabilities. Walking is only one of the many types of movements in which youth engage. Given the dynamic/sporadic nature of youth's activity patterns, the need arises to examine whether pedometers can accurately record activities other than walking. Sixteen youth with developmental disabilities (9 girls, 7 boys,  $13.4 \pm 3.8$  yrs) were videotaped for five minutes during adapted physical education (APE) class while wearing five Walk4Life 2505 pedometers placed in five locations around waist (front right and left, and back right, middle, and left). Subjects engaged in activities consistent with their APE curriculum (e.g., playing catch, volleyball). Researchers viewed each videotape and recorded actual steps and activity time. Findings of each researcher were compared to recorded steps and time (pedometers) for absolute error and transformed into percentages. The absolute percent error across the five pedometer locations for steps (time in parentheses) ranged from 72.8% (65.7%) to 42.3% (32.6%). Across all five pedometer locations, registered steps were underestimated by approximately  $52.9\% \pm 48.9\%$ , whereas pedometer registered time was overestimated by approximately  $22.5\% \pm 53.8\%$ . The findings indicate pedometers may not accurately reflect the dynamic movement youth with disabilities engage during APE.

## 1. Introduction

Pedometry has become a popular method of measuring PA in the school setting because of its moderate to high correlations with other objective measures of PA such as heart rate monitors and accelerometry [1]. Few studies, however, examined the accuracy of pedometers in school age youth with developmental disabilities (DD). Beets and colleagues [2] did report pedometer accuracy for youth with DD but this study was performed under controlled conditions (ie., ramp walking). Therefore, the purpose of this study is to extend the findings of Beets et al. [2] and determine the accuracy of pedometry in children and adolescents with DD engaged in dynamic movements during adapted physical education.

## 2. Experiment, Results, Discussion, and Significance

Sixteen youth with developmental disabilities (9 girls, 7 boys,  $13.4 \pm 3.8$  yrs) were videotaped for five minutes during adapted physical education (APE) class while wearing five Walk4Life 2505 pedometers placed in five locations around waist (front right and left, and back right, middle, and left). Subjects engaged in activities consistent with their APE curriculum (e.g., playing catch, volleyball). Researchers viewed each videotape and recorded actual steps and activity time. Two way mixed model single measure correlation coefficients (ICC) and 95% confidence intervals (95CI) were calculated to determine the agreement between two observers for actual steps and activity time estimates from the videos. Single measure ICCs (95 CI) for actual pedometer steps and activity time were ICCsteps = .95 (95% CI .88 to .98) and ICctime .96 (95% CI .91 to .98), respectively. Given the high agreement between the two raters, the average of actual steps and activity time were calculated and used as the criterion measure to determine accuracy for all subsequent analyses.

For each trial, the absolute difference among registered steps and activity time to actual steps and activity time was computed (registered steps minus actual steps) for each of the five pedometer locations, separately. The difference scores were transformed into two percentages for each location for steps and time, separately, with an average difference score across the five locations calculated for steps and time, separately. Thus, for steps and time, six difference scores were calculated (five for each location and one average across the five locations). For steps, the mean absolute percent error averaged 18.2%, with a mean average percent error of -14%. This meant that across five locations, the pedometer underestimated the number of actual steps taken by 14% (see Table 1). For time, the mean absolute percent error averaged 17.6%; with a mean average percent

error was 8.7%. This means that across five locations, the pedometers overestimated actual movement time by 8.7%

### 3. Conclusions

In conclusion, the results suggest pedometer steps and time do not accurately reflect the dynamic movement youth with disabilities engage in during APE. One should use a cautionary approach to using pedometers when measuring the physical activity levels of youth with DD. Further studies should be conducted to determine the accuracy of pedometer steps and time for dynamic movement involving youth without disabilities during physical education, since pedometry is one of the primary methods being used to determine patterns of daily activity in children and adolescents.

### 4. Acknowledgements

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- [1] Bjornson, K.F. (2005). Physical activity monitoring in children and youths. *Pediatric Physical Therapy*, 17, 37-45.  
 [2] Beets, M.W., Combs, C., Pitetti, K.H., Morgan, M., Bryan, R.R. & Foley J.T. (2007). Accuracy of pedometer steps and time for youths with disabilities. *Adapted Physical Activity Quarterly*. 24, 228-244

Table: 1  
 Absolute Percent Error and Average Percent Error (Observed vs. Pedometer Registered) Steps and Time by Location

	Steps						Time					
	FR	BR	MB	BL	FL	Avg.	FR	BR	MB	BL	FL	Avg.
Absolute percent error												
Average	20.3 <sup>a</sup>	13.6 <sup>ab†</sup>	16.7 <sup>c</sup>	19.0 <sup>b</sup>	26.7 <sup>bc</sup>	18.2	28.4	24.6 <sup>†</sup>	20.5	22.2	20.1	17.6
SD	14.8	10.5	12.8	14.1	14.3	11.4	20.6	19.0	17.6	18.5	17.2	15.2
Average percent error												
Average	-13.8	-6.2	-11.9	-15.8	-22.2	-14.0	18.4	9.0	13.2	-1.4	4.2	8.7
SD	21.2	16.2	17.4	17.7	20.7	16.5	30.2	30.1	23.8	29.2	26.4	21.8

Abbreviations: Abbreviations: FR = front right; BR = back right; MB = middle back; BL = back left; FL = front left; and Avg. = average across all locations

Note: Superscript letters indicate a significant difference between locations. † indicates a significant difference between steps and time for the BR location