

# Identifying predictors of prospective trips and falls in youth with cerebral palsy

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## Summary

Trips and falls are a daily occurrence for some children with cerebral palsy (CP) who ambulate. Our purpose was to identify how balance and the ability to sense ankle position were related to how often children trip and fall. We assessed 11 youth with cerebral palsy and then they tracked how often they tripped or fell for 14 days. A clinical balance test was strongly related to falls, more than ankle position sense. Ankle position sense was better at predicting trips. However, the clinical balance test is not capable of detecting a change for children who have minor impairments, since about one-third of them scored the highest score. Future studies need to identify other measurements to make sure they are appropriate for all individuals, repeatable, and sensitive enough to detect improvements or worsening in balance.

## Introduction

Trips and falls are a nearly daily occurrence for many children with cerebral palsy (CP) who ambulate, and they can cause injuries, embarrassment, and activity avoidance [1]. Despite this, the causes of their falls are unknown, and the use of balance tests sensitive to detect change over time or after intervention is uncommon. Often, only motor impairments are assessed clinically, though sensory impairments may also be present, including ankle position sense impairments [2]. Our purpose was to identify if ankle position sense acuity and clinical balance were correlated with prospective trip and fall incidence among ambulatory youth with CP.

## Methods

Eleven ambulatory youth (age: 12±2 y) with CP who were undergoing a clinically-indicated gait analysis were recruited and completed assessments and trip/fall surveys. All provided consent/assent. Participants were GMFCS level I-III, which represent ambulatory individuals (level I has the least impairment, level III often requires use of assistive devices to walk or stand for prolonged time).

Balance was measured using the Pediatric Balance Scale (PBS, which measures static and dynamic balance). Larger values represent better balance.

Ankle position sense was quantified as the smallest difference between two ankle positions [2]. Smaller values represent greater acuity.

Participants reported trip and fall incidence prospectively by daily report for up to 14 days. % *Days Trip* and % *Days Fall* were calculated to account for uneven number of days tracked and were the primary outcomes.

*Statistics.* Multivariate linear regression was used to assess the predictiveness of PBS and ankle position sense.

## Results and Discussion

Percentage of Days Trip and % Days Fall ranged from 0-69% (mean: 29%) and 0-67% (mean: 24%), respectively. PBS ranged from 34-56 (mean: 51). Six participants (38%) in GMFCS level I displayed ceiling effects as did one in GMFCS level II (8%). Ankle position sense ranged from 1.5°-12.2° (mean: 5.3°).

The regression results show that ankle position sense was predictive of real-world trips but not falls over 14-days, while PBS was predictive of real-world falls but not trips (Table 1).

## Conclusions

This pilot study lends evidence that ankle sense acuity and PBS are modifiable factors that are predictive of real-world trips and falls. It is unclear why the two predictors were significant predictors for one outcome but not the other, since they are related; longer trip/fall monitoring may provide clarity. The PBS did show strong relationships in predicting falls, but it may only be appropriate for individuals who have greater impairment since ceiling effects were present for many children in GMFCS level I. The BESTest or Mini-BESTest or Kids-Mini-BESTest have been proposed as alternative balance measures, though their ability to predict trips or falls has yet to be investigated in this population. Larger and longer prospective studies are needed to see if results replicate and whether hip and knee position sense are also predictive of trips, falls, and severe fall-related injuries.

## Acknowledgments

We thank the participants and the Endowed Fund for Cerebral Palsy Treatment of Gillette Children's for funding.

## References

- [1] Esterley et al. (2024). *Arch Phys Med Rehab*, doi.org/10.1016/j.apmr.2024.12.010.
- [2] Boyer ER et al. (2024). *J Ped Rehab Med*, 17: 75-83

**Table 1:** Multivariate regression predicting percentage of days where trips or falls occurred.

% Days Trip	n	b ± s.e.	p-val	R <sup>2</sup>	% Days Fall	n	b ± s.e.	p-val	R <sup>2</sup>
Ankle position sense	10	0.05±0.02	0.029	0.53	Ankle position sense	11	0.01±0.02	0.664	0.52
PBS	10	-0.007±0.007	0.34		PBS	11	-0.025±0.009	0.018	