Background/Overview	
Article Citation	Dibble LE, Lopez-Lennon C, Lake W, Hoffmeister C & Gappmaier E. Utility of disease-specific measures and clinical balance tests in prediction of falls in persons with Multiple Sclerosis.*JNPT* 2103;37:99-104.
Study Objective/Purpose (hypothesis)	To determine which demographic and disease-specific characteristics differed between fallers and non-fallers with Multiple Sclerosis (Hypothesis: The majority of individuals in study would fall in the subsequent year and that those who fell would have greater neurological deficits as measured by the Functional Status Scale of the EDSS.) Secondary objectives were to 1) compare the validity of 5 common clinical balance tests in determining prospective fall risk and 2) compare the accuracy of monthly recall versus annual recall of fall events. (Hypothesis: all balance tools would demonstrate sensitivity to predict fallers, with no one test being superior, and that persons with MS would not be able to accurately recall the number of fall events that occurred over a one year period)
Brief Background (why issue is important; summary of previous literature)	MS is a chronic, progressive neurological disease that leads to motor and sensory changes and, for many, significantly alters balance and gait. As a result, over 50% of persons with MS report falling more than two times per year. While researchers have begun to assess the ability of currently available clinical measures of balance and gait to identify or predict fallers with MS, the majority of published work utilized retrospective fall data. This current study uses prospective fall frequency over a 12 month period as means to identify fallers. This length of time is especially relevant for persons with MS who are young, active and desire to interact in their community.
Methods	
Study Design (type of trial, randomization, blinding, controls, study groups, length of study, follow-up)	This was a prospective study that used a single sample of accessible individuals with MS. Participant disease related disability was classified using the EDSS. Participants completed 5 clinical balance tests and then were followed for one year. They were surveyed monthly by phone to track the number of falls that had occurred that month. At month 12, participants were also asked to report the total number of falls they had in the past year. A fall was operationally defined as an event that resulted in

	"unintentional contact with the ground or a lower surface (excluding overwhelming internal or external events, such as illness or ice)". Individuals that reported falling two or more times in the 12 month were classified as fallers.
Target Population (dx, acuity, inclusion/exclusion critieria)	The participants were selected from an accessible sample of 49 community dwelling adults with MS (mean age= 53 yrs) who were capable of continuously walking 25 meters independently with or without an assistive device. Of those 49, 38 individuals were consented for and completed the study. Exclusion criteria included medical or cognitive condition that prohibited participation in a 12 month prospective balance study.
Interventions (if applicable): (specificity of interventions, ability to replicate, frequency, duration)	This was not an interventional study
Outcome Measures (relevant to purpose of the study; reliable, valid, clinical utility)	Extended Disease Status Scale: a valid and reliable tool used to quantify disease related disability in persons with MS. This is an ordinal scale ranging from 0-10, which a larger number indicating greater disease related disability. This tool is normally administered by a Neurologist. Activity –based Confidence Scale: a standardized self-report measure used to assess balance confidence with strong inter and intra-rater reliability (ICC= 0.96; 0.91) and the ability to show differences between fallers and non-fallers with MS in previous studies. Berg Balance Scale: an assessment of static balance without use of an AD with strong test/retest reliability (ICC = 0.96) in this population. Previous research has indicated that a ceiling effect does exist with this tool in persons with MS. Dynamic Gait Index: 8 items assessment of gait related mobility and dynamic balance. Test/restest reliability is good (ICC = 0.76- 0.99) and interrater reliability is very strong (0.98) using a sample of ambulatory individuals with MS. Timed Up & Go: quick measure of mobility and dynamic. This tool has high test/retest reliability (ICC = 0.91) but no validity testing in this population.

** all clinical tools have strong reliability for use with the MS population. More diagnostic specific information is needed to validate their use in MS, which is the one of the strengths of this study. It contributes to this gap in the literature. |
| Statistical Analysis (statistics used, appropriate application) | Descriptive statistics were used to calculate the demographic variables of the subjects, including over |

| | all percentage of the sample that were classified as fallers. Once separated by fall classification, additional descriptive statistics (mean, SD and 95% confidence interval) for age, body mass index (BMI) and time since diagnosis were also calculated. The researchers chose to use separate non-parametric tests (Mann-Whitney U tests) to calculate differences between groups comparisons for all outcome measures. The sensitivity and specificity were calculated for each clinical balance tool using the participants prospective fall history as the gold standard. Plotting the sensitivity (true positive) on the *y*-axis and 1-specificity on the *x*-axis, a receiver operating characteristic (ROC) curve was generated for each of the clinical balance tools and the EDSS. Lastly, the area under the curve (AUC) for each ROC curve and the confidence intervals about the curve were determined.

To examine the accuracy of fall recall, a ratio was calculated using the sum of the total falls reported each month as compared to the 12-month retrospective total.

Use of confidence intervals and ROC curve allow for clear understanding of data analysis. Author correctly clarified that the AUC values were all below acceptable levels to classify any of the tools as accurate enough to use in isolation for fall prediction in this patient population. |
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| **Results** | |
| Enrollment/Subject Characteristics (sample size, gender, age, functional level; were groups similar on important variables prior to application of the intervention) | Of the initial 49 participants, 38 participants (mean age 53.6 years $\pm$ 10.6 years, 25 women and 13 men) underwent the initial tests and remained in the study for the full 12 months. Of the 38, 23 (61%) were classified as fallers, falling a total of 343 times, with an average of 6 falls per person in 12 months. There was no significant difference in BMI, age, and disease severity between the two groups: fallers and non-fallers. |
| Summary of Primary and Secondary Outcomes (include aggregate and sub-group findings if reported); note results that were statistically significant; How many reached a level of clinical significance (exceed MCID if known); Was there retention of changes following intervention (if studied) | Of the six measures studied, only the ABC, the BBS and the DGI demonstrated significant differences between fallers and non-fallers (P <0.05). The ROC analysis of each measure was used to evaluate the predictive validity of each tool in isolation. No tool demonstrated the prediction accuracy to be able to be used in isolation (no test had an AUC > 0.75).

Minimally clinically important differences (MCID) were not calculated I this study. This would be important additional information to study in future work.

Using the monthly record as the accurate count, the researchers determined that 78% of the participants inaccurately reported their fall occurrences. |
| **Authors' Discussion and Conclusions** | |

| Brief Summary of Authors' Main Discussion Points; Authors' Conclusion | The majority of the participants in this study fell more than twice during a 12-month follow-up period. The EDSS, a measure of disability, was not significantly different between the faller and nonfaller groups. This suggests that the presence and severity of neurologic deficits, as measured by the EDSS, cannot predict fall risk.

Of the 5 clinical balance tests examined, only the BBS, DGI and ABC were accurately able to predict fallers. These 3 tools also demonstrated clinically useful levels of sensitivity and specificity for indication of a future fall but no one tool demonstrated strong enough accuracy to be used in isolation.

Participants in this study could not accurately provide retrospective fall history using a 12 month window. |
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| **Reviewer's Discussion and Conclusion** | |
| Study Strengths | Use of commonly used clinical balance tools, prospective design with a 12 monitoring period, use of ROC curve and reporting of 95% confidence intervals |
| Study Limitations and Potential for Bias | The participants consisted of a small (38) number of volunteers from defined neurological and rehabilitation programs and therefore the participant group may have been biased toward higher motivation and overall function. |
| Applicability:
• Types of patients (dx) that results apply to
• Types of settings or patient acuity that the results apply to
• Can interventions be reproduced? Can results be applied to other pt populations? | This study was designed to look at the diagnostic accuracy of five clinical balance tests for persons with MS. The results support findings in other studies that indicate that ABC and the DGI scores significantly differ when persons with MS are classified as fallers and non-fallers. The study findings also support the use of the Berg Balance Scale to identify individuals with MS predicted to fall two or more times in the next year. Additionally, results of this study led the researchers to conclude that participants in this study were generally inaccurate in their long-term recall of fall events. This information is important for clinicians and researchers using reduction in fall events as a measure of success of fall-prevention research. |

| How will study results impact PT management of this patient population?; List suggestions for how to implement changes in your clinic/department to integrate study findings into patient care | Previous research in the area of identifying fall risk cautions against the use of one measure as a means of categorizing a person at risk for a fall. As a result, clinicians may then opt to use a combination of measures to aide in assessment of fall risk, of which there are many to choose from. The results of this study should guide the clinician working with the ambulatory MS Population to consider the use of ABC, BBS, DGI as part of a comprehensive assessment. |