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Melissa Chan

Nova Southeastern University, Fort Lauderdale, mc3144@nova.edu

Shari Rone-Adams

Nova Southeastern University, srone@nova.edu

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Outcome Measures for Mild Balance and Cognitive Decline in a Pre-Old Adult: A Case Report

Background and Purpose. Early detection and treatment of age-related decline, particularly balance and cognition, are increasingly being emphasized in current research. However, the majority of research on older adults focuses on participants who are 65 years and older. For individuals who are 60-64 years old, this is an age range where they may or may not be considered an older adult. This poses a problem applying the results of these studies to pre-old adults to accurately diagnose, measure and classify risk in the areas of cognition and balance. **Case Description.** The patient is a 61-year-old woman with a clinical diagnosis of osteoporosis. She has had 5 falls and near-falls in the past year. She also experiences memory problems, which sometimes affects her ability to plan and organize her schedule. She is otherwise well, with no limits to participation. **Outcomes Assessment.** Frequently used clinical tools to assess for mild balance and cognitive deficits were performed in order to detect diagnosis and/or classify risk. A total of 14 tools related to balance and falls, and 4 tools related to cognition were chosen. **Results.** Of the assessment tools used, only the Mini Balance Evaluation Systems Test (Mini BESTest), High Level Mobility Assessment Test (HiMAT), and the Falls Efficacy Scale-International (FES-I) were able to identify and classify risk of fall and/or balance deficits. Of the cognitive tools performed, only the Montreal Cognitive Assessment (MoCA) produced abnormal results, suggesting cognitive decline. **Conclusions.** Many of the frequently used clinical assessment tools were unable to identify falls history and balance deficits in this patient. In view of the lack of sensitivity in balance assessment tools in pre-old adults and the multiple factors associated with falls risk, it is difficult to conclusively determine if she does have balance deficits and to quantify her risk of future falls. Cognitive screening in this patient suggests that an algorithmic approach using the Mini Mental State Examination (MMSE) and the MoCA may be effective in screening for mild cognitive impairment (MCI). More research should be directed towards the development and validation of sensitive instruments to detect mild balance deficits and screening for MCI, especially in the pre-old adult.

Author Bio(s)

Melissa Chan, PT, is a licensed physical therapist in Singapore. She is currently a student in the Transition-Doctor of Physical Therapy Program at Nova Southeastern University, Fort Lauderdale.

Shari Rone-Adams, PT, MHSA, DBA, is the Chair and Associate Professor in the Physical Therapy Department at Nova Southeastern University, Fort Lauderdale. Dr. Rone-Adams is a member of the Alpha Eta National Honor Society, Nu Sigma Upsilon Chapter. She has also completed the APTA's Clinical Instructional Education and Credentialing Program and is a Credentialed Clinical Instructor.

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Melissa Chan, PT
Shari Rone-Adams, PT, MHSA, DBA

Nova Southeastern University

United States

ABSTRACT

Background and Purpose. Early detection and treatment of age-related decline, particularly balance and cognition, are increasingly being emphasized in current research. However, the majority of research on older adults focuses on participants who are 65 years and older. For individuals who are 60-64 years old, this is an age range where they may or may not be considered an older adult. This poses a problem applying the results of these studies to pre-old adults to accurately diagnose, measure and classify risk in the areas of cognition and balance. **Case Description.** The patient is a 61-year-old woman with a clinical diagnosis of osteoporosis. She has had 5 falls and near-falls in the past year. She also experiences memory problems, which sometimes affects her ability to plan and organize her schedule. She is otherwise well, with no limits to participation. **Outcomes Assessment.** Frequently used clinical tools to assess for mild balance and cognitive deficits were performed in order to detect diagnosis and/or classify risk. A total of 14 tools related to balance and falls, and 4 tools related to cognition were chosen. **Results.** Of the assessment tools used, only the Mini Balance Evaluation Systems Test (Mini BESTest), High Level Mobility Assessment Test (HiMAT), and the Falls Efficacy Scale-International (FES-I) were able to identify and classify risk of fall and/or balance deficits. Of the cognitive tools performed, only the Montreal Cognitive Assessment (MoCA) produced abnormal results, suggesting cognitive decline. **Conclusions.** Many of the frequently used clinical assessment tools were unable to identify falls history and balance deficits in this patient. In view of the lack of sensitivity in balance assessment tools in pre-old adults and the multiple factors associated with falls risk, it is difficult to conclusively determine if she does have balance deficits and to quantify her risk of future falls. Cognitive screening in this patient suggests that an algorithmic approach using the Mini Mental State Examination (MMSE) and the MoCA may be effective in screening for mild cognitive impairment (MCI). More research should be directed towards the development and validation of sensitive instruments to detect mild balance deficits and screening for MCI, especially in the pre-old adult.

INTRODUCTION

In the wave of the silver generation, increasing emphasis is being placed on the importance of early detection and treatment of age-related decline. Two areas of particular concern are cognition and balance. These are key factors influencing an individual's ability to remain independent in living and functioning and are topics of great interest in current research. However, a large proportion of current research has been performed on individual's age 65 years and older. This constitutes the definition of an "older adult" in many high-resourced countries who use this cut-off to identify eligibility for financial and healthcare benefits.^{1,2} Yet, the definition of an older adult according to the United Nations is 60 years and older.¹

Recently, there have been emerging trends in acknowledging that the concept of ageing should not be restricted to chronological age alone, but should consider all characteristics of ageing, such as disability, health, remaining life expectancy, and cognitive functioning.³ This highlights an issue of concern: persons between 60-64 years old appear to fall under a category that is often ignored by the medical and research communities because they are perceived to be too young for a geriatric population, but too old to be considered middle-aged in research contexts. Yet, it is not unusual that many of these individuals who fall within this age

range already begin to exhibit age-related decline, which is a reflection of the aforementioned emerging concepts of ageing.³ This only serves to further support the relevance of early intervention programs in this group of older adults. Despite this, there is little research on the diagnosis and classification of all risk for this group of at-risk individuals who will eventually contribute to a growing base of chronic consumers of the healthcare system.

The term “young-old” has been used to describe individuals whose age falls within the range of 65-75 years.⁴ As a topic of interest and for the purpose of this report, the term “pre-old adult” will henceforth refer to individuals within the age range of 60-64 years, to identify this group that is often left out in the literature.

Balance, which is known to be controlled by extremely complex mechanisms, is but one factor in predicting falls risk.^{5,6,7} Nonetheless, gait and balance have proven to be consistently correlated with falls and are collectively the second highest causative factor, hence it remains a focal point of both researchers and clinicians alike.⁸ Recently, compelling evidence has also linked cognitive function with gait and balance, further demonstrating the multi-faceted relationships between these factors of age-related decline.⁶ Yet, precisely because of the complex nature of balance, it is difficult to identify and quantify mild deficits using a single clinical tool.⁵ This challenge is further compounded in a high-level functioning individual who has not yet reached the definitive threshold of an ageing adult, since many of the validation studies for clinical assessment tools often use the cut-off age of 65 years for their participants.^{5,6} This poses a problem to applying the results of these studies to pre-old adults to accurately diagnose, measure and classify risk.

Given that cognition directly impacts a patient’s ability to participate in physical therapy (PT), as well as increasing evidence that cognition affects gait and balance, it is imperative that therapists have the tools to accurately screen for cognitive deficits.⁶ However, in a similar light to balance assessment, there is no single best screening tool for cognitive decline, although a few instruments have proven to be consistently popular in the literature and in practice.⁹ It is now generally recognized that the transition between normal cognition and early dementia is a clinical entity known as mild cognitive impairment (MCI).¹⁰ Although the specific characteristics and criteria of MCI have yet to be conclusively agreed upon, a main sign is reduced memory performance.^{10,11} Because of the variability of symptoms and the validity and reliability of individual cognitive tools, diagnosing MCI can be a very challenging process.¹⁰ This subsequently presents a major barrier to selecting appropriate and accurate screening tools for MCI.

Detecting deficits is the first and crucial step to planning for and implementing intervention strategies. Failure to accurately identify deficits in a patient compromises the management plan and hence, can adversely impact prognosis. This case report aims to explore and demonstrate the challenges in detecting mild balance deficits and MCI in a pre-old adult from a PT perspective. Emphasis will be placed on the clinical utility and comparison of frequently used, functional, and validated assessment tools to screen for mild balance and cognitive deficits. Each of these tools will be described in Table 1. A brief outline of PT management plans will also be discussed.

CASE DESCRIPTION

History & Background

The patient is a 61-year-old woman diagnosed with osteoporosis, chronic gastritis, high cholesterol, and occasional lower back pain due to vertebral degenerative changes. She is a homemaker and looks after her young grandchildren, in addition to providing administrative assistance to her business-owner husband. She performs light household chores, walks in the community without limitations, and frequently travels overseas. Her medication list includes risedronate and esomeprazole, as well as calcium and vitamin D supplements.

This patient has never been formally referred to PT as her problems have not been deemed serious enough to warrant intervention. However, she agreed to this assessment that was offered mainly in lieu of her falls and cognitive history, in order to investigate potential deficits.

Falls History

In the past year, the patient has had 2 falls and 3 near-falls. In two of these incidents, she was tripped or caught from behind by wheelchair users while out in the community. In these cases, she was unable to adequately arrest her imbalance through compensative mechanisms after wheelchairs had caught on her shoes from behind, resulting in 1 fall and 1 near-fall. In the other three events, she had lost balance: once at home on steps; twice in the community from experiencing imaginary thresholds and feeling “off-balance.” She describes these experiences as “feeling as though something is in the way” and thus she takes an extra-large or high step where it was not necessary. This resulted in internal perturbations that she was unable to recover from, resulting in 1 fall and 2 near-falls. None of the falls or near-falls resulted in injury requiring medical treatment.

Cognitive Symptoms

The patient reports experiencing poor short-term memory and occasional difficulty with maintaining her schedules in recent years. This sometimes results in conflict with her family members since she tends to forget prior engagements, which affects her ability to organize and plan activities. She is still able to manage her finances, medical appointments, and medications independently.

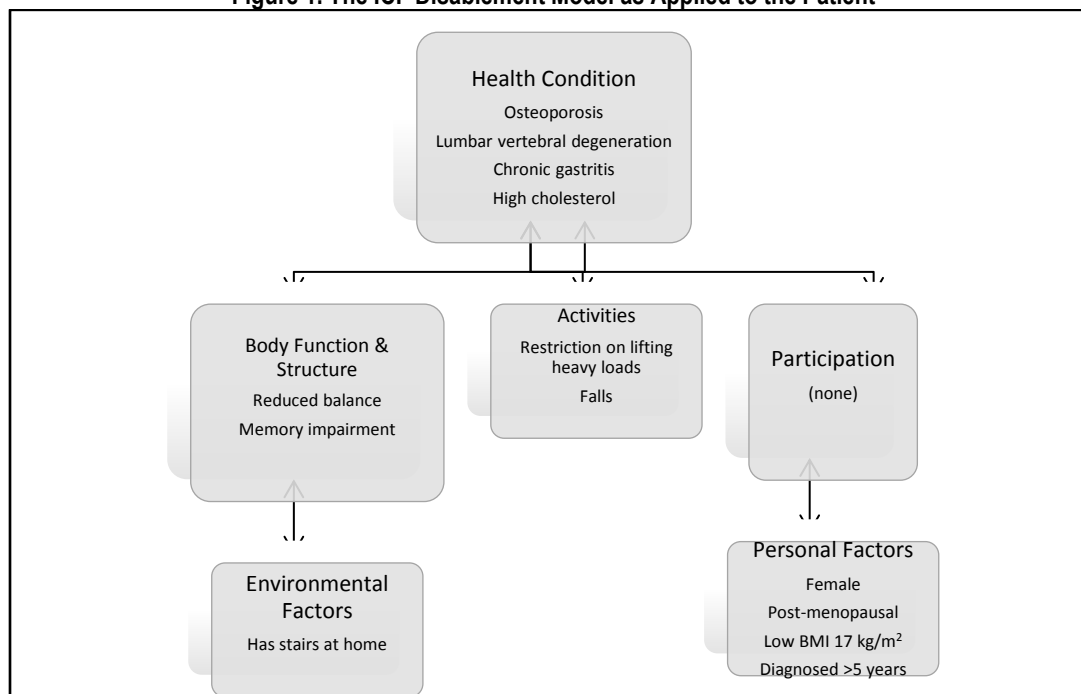
Physical Examination

The patient is able to perform all functional activities independently and safely. She is able to walk on flat ground steadily and safely without aid, even in various footwear, including high heels. She is able to walk up and down the stairs without rail support using a reciprocal gait pattern. Gross motor strength is 5/5 on the manual muscle testing (MMT) scale for all extremities. Range of motion for all major joints are within normal limits, including trunk forward flexion and extension, and posture appears normal. Light touch sensation and sharp/dull testing is normal. Proprioception testing to the hips, knees, ankles, and first metatarsal joint is normal. There are no complaints of pain or discomfort on examination.

Disablement Model

The International Classification of Function, Disability and Health (ICF) model is often used to identify and highlight areas of concern for the clinician.¹² The patient's pertinent problems are outlined in Figure 1.

Figure 1. The ICF Disablement Model as Applied to the Patient



Given that the patient is able to continue daily functional activities and has no limitations to participation, the focus of her problems is on detection of risk factors for future impairment or disability. The largest concern from a PT perspective is her history of and risk of falls. This is especially significant for her as the risk of serious injury and fracture from a fall is increased in patients with osteoporosis, particularly in the presence of falls history.¹³ Additionally, screening for MCI is crucial for implementation of strategies and interventions that may delay progress to more serious conditions such as dementia, or to facilitate planning for the future.¹⁴ As discussed previously, the key issue with assessing mild balance and cognitive deficits in this patient surrounds the selection and application of valid clinical tools. Cut-off scores for these assessment tools may not accurately discriminate this patient's results due to the age difference from participants in the validation studies, and thus would affect the specificity and sensitivity of the tool when performed on this patient. This would directly impact whether or not the patient receives PT therapeutic intervention and subsequently, affect prognosis. With regards to cognition, evidence of decline would impact the PT's decision to refer the patient for formal medical diagnosis and appropriate treatment.

ASSESSMENT USING CLINICAL OUTCOME MEASURES

Assessment tools were considered based on clinical relevance and established use in research. In accordance with viewing the patient from a diagnostic and functional perspective, outcomes specific to and targeting osteoporosis, such as spinal curvature and postural assessments, are beyond the scope of this paper and will not be explored in detail. Balance assessment tools that focus on dynamic balance and have the ability to classify falls risk were selected. In the majority of these tools, risk of fall is inferred from the presence of balance deficits. In cases where clinical tools were revisions of previous versions, the more updated or valid one was used, such as where the Functional Gait Assessment was preferred over the Dynamic Gait Index.

Self-reported scales of fear of falling were performed to assess for functional limitation and to demonstrate potential correlation with objective balance outcomes.⁵ Outcomes measuring lower limb strength were also included as part of a comprehensive assessment relating to factors associated with higher falls risk.⁸

Table 1. Description of Balance and Cognitive Assessments Used

Outcome Measure	Description
Balance - Performance	
TUG¹⁵	The TUG examines functional mobility and has correlation with independence in activities of daily living and gait speed in older adults. The subject is required to stand up from a chair, walk 3m, walk back, and sit down is recorded.
SLS¹⁶	Shorter single leg stance time is associated with a history of falling in older adults. The subject is asked to stand on one foot while keeping the legs from touching. The total time until the subject shifts the stance foot or places the lifted foot on the floor is recorded. The best time from 3 trials is usually recorded.
FRT¹⁷	The FRT assesses stability by measuring the maximum distance the subject can reach with the arms while standing in a fixed position. The average of 3 trials is usually recorded.
FSST¹⁸	The FSST tests two aspects of balance: the ability to step over low objects, and the ability to step quickly in different directions. The test is performed by laying two canes in a cross on the floor and having the subject step in a clockwise, then anti-clockwise direction. The total time to complete the sequence is recorded.
BBS¹⁹	The BBS is a 14-item measure of mostly static balance, and is associated with falls risk in older adults. Transfers, turning, the FRT, and the SLS are some of the components tested.
mCTSIB²⁰	The mCTSIB is a modified version of the CTSIB and examines postural control under different sensory conditions. The subject is timed for each condition and the average of 3 trials are recorded.
FGA²¹	The FGA is a 10-item test that assess stability during various walking tasks. It was modified from the Dynamic Gait Index to improve reliability and reduce the ceiling effect.
Tinetti POMA²²	The POMA is a 16-item test that assess postural stability and gait. In the POMA-B (Balance), the subject is tested on several transfer tasks associated with activities of daily living. In the POMA-G (Gait), the subject's gait pattern is examined. Results from each category are summed up to give the POMA-T (Total) score.
FAB²³	The FAB is a 10-item scale that assesses various dimensions of balance. These include static and dynamic balance activities performed in different sensory environments.
Mini-BESTest²⁴	The Mini-BESTest is a 14-item test that is a shortened version of the BESTest. It assesses important aspects of dynamic balance, including postural response to perturbation and gait stability.
HiMAT²⁵	The HiMAT is a 13-item test of high level mobility originally developed for patients with traumatic brain injury. It assesses the subject's performance on items such as walking, running, skipping, and bounding.

Outcome Measure	Description
Balance – Self-reported	
FES-I²⁶	The FES-I is a 16-item questionnaire exploring an individual's level of concern about falls during activities of daily living. This includes scenarios related to both indoor and outdoor activities.
ABC²⁷	The ABC is a 16-item questionnaire exploring an individual's level of confidence of not falling while performing various activities of daily living. The individual is asked to rate confidence level for each item in terms of percentage.
Cognition	
GPCOG⁹	The GPCOG is a dementia screening tool used by general practitioners. The first section is a 9-item test that assesses orientation, clock drawing, information, and recall. If the individual scores between 5-8 points, an interview is conducted with an informant or caregiver.
MMSE⁹	The most commonly-used instrument for screening cognitive impairment, the MMSE is an 11-item test that assesses orientation, registration, attention and calculation, recall, language, and copying.
MoCA²⁸	The MoCA is a 12-item test that is similar to the MMSE but with more difficult tasks such as executive function.
Mini-Cog⁹	The Mini-Cog is a brief screening test of dementia originally developed in community-dwelling older adults. It comprises a 3-item recall and clock drawing test.
Lower Limb Strength	
30s STS²⁹	The 30s STS is used to assess functional lower limb strength in older adults. The number of times the subject can sit and stand fully from the chair within 30 seconds is recorded.
<p><i>TUG= Timed Up and Go; SLS= Single Leg Stance; FRT= Functional Reach Test; FSST= Four Square Step Test; BBS= Berg Balance Scale; mCTSIB= Modified Clinical Test of Sensory Interaction in Balance; HiMAT= High Level Mobility Assessment Tool; Mini-BESTest= Mini Balance Evaluation Systems Test; FGA=Functional Gait Assessment; Tinetti POMA= Tinetti Performance Oriented Mobility Assessment; FAB= Fullerton Advanced Balance Scale; FES= Falls Efficacy Scale-International; ABC= Activities-Specific Balance Confidence Scale; GPCOG= General Practitioner Assessment of Cognition; MMSE= Mini Mental State Examination; MoCA= Montreal Cognitive Assessment; Mini-Cog= Mini Cognitive Assessment Instrument; STS = Sit To Stand</i></p>	

Assessments were separated into the balance and cognitive categories and were performed by a single, trained physical therapist. Cognitive assessments were completed within the same day, while the balance assessments were divided into two sessions due to time limitations. Effort was made to ensure the assessments were performed under the same conditions, including time of day and environment. Adequate rest time was given between each assessment, and the patient was monitored for fatigue or boredom both subjectively and objectively. The results for the patient in this case are listed in Table 2.

Table 2. Results of Balance and Cognitive Assessments Performed On the Patient

Outcome Measure	Score	Established Cut-off	Sensitivity	Specificity
Balance - Performance				
TUG ¹⁵	10.6 s	≥13.5 s	87%	87%
SLS ¹⁶	>30 s	<30 s	91%	75%
FRT ¹⁷	39.4 cm	<18.5 cm	75%	67%
FSST ¹⁸	8.30 sec	>15 sec	85%	88%
BBS ¹⁹	56/56	≤51/56	91% ^b	82% ^b
mCTSIB ²⁰	120/120 sec	<120 sec	83-91%	36-57%
FGA ²¹	27/30	≤22/30	100%	72%
Tinetti POMA ²²	27/28	19/28	64%	66.1%
FAB ²³	33/40	≤25/40	74.6%	52.6%
Mini-BESTest ²⁴	21/28 ^a	18-21/28 (moderate)	Not determined for this cut-off score	
HiMAT ²⁵	26/54 ^a	<48/54	70%	75%
Balance – Self-reported				
FES-I ²⁶	23/64 ^a	20-27/64 (moderate)	Not determined for this cut-off score	
ABC ²⁷	94.4%	≤67%	84.4%	87.5%
Cognition				
GPCOG ⁹	9/9	<5/9	85%	86%
MMSE ⁹	30	<24/30	69%	89%
MoCA ²⁸	24/30 ^a	<26/30	90%	87%
Mini-Cog ⁹	4/5	By algorithm	76%	89%
Lower Limb Strength				
30s STS ²⁹	18 reps	12-17 reps	NA	
<p>TUG= Timed Up and Go; SLS= Single Leg Stance; FRT= Functional Reach Test; FSST= Four Square Step Test; BBS= Berg Balance Scale; mCTSIB= Modified Clinical Test of Sensory Interaction in Balance; HiMAT= High Level Mobility Assessment Tool; Mini-BESTest= Mini Balance Evaluation Systems Test; FGA=Functional Gait Assessment; Tinetti POMA= Tinetti Performance Oriented Mobility Assessment; FAB= Fullerton Advanced Balance Scale; FES= Falls Efficacy Scale-International; ABC= Activities-Specific Balance Confidence Scale; GPCOG= General Practitioner Assessment of Cognition; MMSE= Mini Mental State Examination; MoCA= Montreal Cognitive Assessment; Mini-Cog= Mini Cognitive Assessment Instrument; STS = Sit To Stand</p> <p>^a indicates an abnormal score indicating increased risk of fall or cognitive deficit</p> <p>^b when combined with history of imbalance</p>				

RESULTS OF OUTCOME MEASURES

Balance

The results of the TUG, SLS, FRT and FSST do not indicate that this patient is at risk of fall based on established cut-off points.¹⁵⁻¹⁸ The patient obtained maximum scores on the BBS and the mCTSIB. Results on the FGA, Tinetti POMA, and the FAB scales also reflect negative prediction of falls based on established cut-off points.²¹⁻²³ Of the tests that reflect an abnormal score, the Mini-BESTest indicates a moderate balance deficit and predicts a higher risk of fall.²⁴ The results on the HiMAT indicate the presence

of balance problems as it is well below the cut-off score of 47, although this has only been validated in patients with traumatic brain injury.²⁵

Of the self-reported measures, only the FES-I identified moderate concern of falling and predicted risk of future fall using established cut-off scores.²⁶ The ABC scale failed to identify a history of falls in this patient, and predicts a low risk of future fall.²⁷

Cognition

The patient attained maximum scores on the MMSE and the GPCOG. The result of <26/30 on the MoCA indicates cognitive impairment, but not dementia, using a cut-off score of $\leq 20/30$.^{28,30} A recent study using a validated Chinese version of the MoCA further suggested that a cut-off score of $\leq 24/30$ was able to detect dementia in 60-79-year-olds.³¹ Results on the Mini-Cog indicate that the patient is non-demented.^{9,32}

Lower Limb Strength

The patient completed 18 repetitions on the 30s STS, which is above normative data for her gender and age range.^{29,33} This indicates normal functional lower limb strength.

DISCUSSION

Balance

Traditionally, simple performance tests such as the TUG, SLS, FRT, and the FSST have been used in clinical settings to identify balance deficits and classify falls risk in older adults.⁵ However, most of these tests were validated in patients ≥ 65 years old who tended to be frailer and with higher levels of balance deficits. The recognition of balance as a complex construct and its relation to falls risk has prompted a movement towards an increased use of combined assessments and batteries of tests in the form of ordinal scales to detect and quantify balance deficits.⁵ This is supported by a previous study that found that a history of falls in women with osteoporosis was present even in those with good standing balance and lower limb strength.³⁴ Only the Mini-BESTest and the HiMAT were specific enough to detect balance deficits in this patient.

The Mini-BESTest has been found to have minimal to no ceiling effects compared to the BBS in non-neurological populations, and higher accuracy at discriminating between fallers in a general population than the BBS, with a sensitivity of 85% and specificity of 75%.^{35,36} The discriminant validity of the Mini-BESTest has also been consistent in the literature regarding evidence in various neurological populations.³⁷ This has proven accurate in the case of this patient in that it was able to identify the history of falls using a cut-off score of 16/28, and was the only instrument assessing objective balance to successfully do so.³⁶ On the other hand, an issue of greater importance from a clinical perspective is the ability to predict falls. The patient's results on the Mini-BESTest lies on the upper limit of the established range, suggesting that the patient is at risk of fall.²⁴ The utility of the Mini-BESTest is even more promising given the validation of this tool in persons older than 60 years.^{24,38}

Although the HiMAT was also able to detect balance deficits in this patient, it is not the best choice of assessment tool as it was developed for and has only been validated in patients with traumatic brain injury.²⁵ Nevertheless, it appears to warrant merit in its ability to detect mild balance deficits where other instruments failed. Consideration should be made in validating or modifying this tool for use in the general older community-dwelling population.

The FAB is a performance measure scale developed specifically to address balance problems in high-functioning older adults.³⁹ Despite this, the FAB failed to discriminate falls history and risk in this patient when using the cut-off score of 25/40, which is at the optimum level of balance between sensitivity and specificity.²³ Moreover, even at this cut-off value, specificity remains generally lower than sensitivity, and specificity decreases with higher total scores.²³ Specificity for this tool for total scores $\geq 30/40$ was found to be exceedingly poor at less than 20%, meaning that the tool was all the more unable to correctly identify fallers who scored within this range.²³ In addition, one item on the FAB is contraindicated in persons with osteoporosis (Item 8, two-footed jump), for which they would automatically receive a score of 0. This did not affect the predictive ability of the scale for this patient, although this is also not surprising given the lack of validation of its use in adults with osteoporosis.

It should be noted that a key characteristic of the Mini-BESTest that distinguishes it from the other tools is the assessment of reactive postural response.³⁸ This was a subsystem in which the patient performed most poorly, and which is not found in many balance assessments as most usually test volitional, but not external perturbation. However, this was not found to be a strong predictor variable in the FAB scale and has not yet been specifically investigated in the Mini-BESTest.²³ Previous studies have suggested that individuals with higher functioning fall due to extrinsic factors rather than balance deficits.³⁸ This is congruent with the finding that most falls in the elderly occur due to accidents or the environment, and accurately reflects falls history in this patient.⁸

Interestingly, the ABC scale failed to detect falls history and risk in this patient, despite a sensitivity of 84.4% for the cut-off of 67%.²⁷ Although both the ABC and the FES-I offer similar clinical outcomes, the FES-I has been shown to correlate better with females' body composition, functional abilities, and health-related characteristics when self-evaluating their risk of falling. Hence, this may explain why the FES-I performed better in this patient. Because of its relationship with multiple predictor characteristics, the FES-I has been recommended over the ABC for use in community-dwelling older adults.⁴⁰

Cognition

The MMSE and the MoCA are two commonly used screening tools for cognitive decline, and are popular for their brief and simple administration. Previous studies have shown that the MoCA has higher sensitivity than the MMSE in detecting MCI, and with excellent positive and negative predictive values for MCI.^{28,41} In the original paper by Nasreddine et al, recommendations were made to use an algorithmic approach, namely to administer the MoCA only if the MMSE score was normal.²⁸ Similarly, the MoCA only should be administered if there were cognitive complaints without functional impairment, since the MMSE score was likely to be normal.²⁸ This practical approach was supported by later studies and by the results of the patient in this case.³⁰

The GPCOG and Mini-Cog are two other popular and effective screening tools for dementia demonstrating higher negative predictive values than the MMSE.⁹ However, these have not been validated in MCI, which, as discussed earlier, is clinically different from a diagnosis of dementia. Given their similar psychometric properties to the MMSE and its poor sensitivity in detecting MCI, it is therefore unsurprising that the patient obtained normal scores for these tests.

Implications for Intervention

Balance Training

The results of the balance assessment battery present a key concern: does this patient have mild balance deficits? And, perhaps more importantly, should she receive therapeutic intervention to prevent future falls? In view of the lack of sensitivity in balance assessment tools in pre-old adults and the multiple factors associated with falls risk, it is difficult to conclusively determine if she does have balance deficits and to quantify her risk of future falls. Furthermore, given that the majority of falls in older adults are caused by extrinsic factors, traditional methods of falls prediction may not be fully applicable to this patient.⁸ However, given this patient's falls history and positive results on at least one outcome measure, it would not be unreasonable to err on the side of caution from a clinical perspective and to provide some form of intervention to address balance and falls risk. Since there can be a fine line between preventative and active treatment, the dilemma for the PT is not likely to be whether or not to treat this patient, but rather the method of delivery and the issues surrounding the logistic and administrative aspects of the interventions. That is, should this patient receive a one-time session of education and balance exercises, or should she join a targeted balance program that runs for 12 weeks? Are these costs claimable from third-party payers? The ambiguity in falls risk assessment has implications not only from a clinical perspective, but also from the legal and administrative standpoint where it can be difficult to justify decisions based on inexplicit results.

These issues notwithstanding, most rehabilitative interventions targeted at patients with osteoporosis in the literature tend to focus on balance and strength training in order to reduce falls risk. In the case of this patient, interventions focusing on balance training should be prioritized over strength training because her functional strength was determined to be normal. However, there is, to date, no research that investigates the effectiveness of balance training programs in persons with osteoporosis and only mild balance deficits, simply because it is difficult to classify the latter. There are some limitations to extrapolating results from current research to this case. Firstly, most research on balance training has been performed on participants aged 65 years and older or tend to include those with more frailty. Secondly, most outcome measures used in current research are not sensitive enough to detect mild balance deficits and to correlate with falls risk prediction.⁴²

Nevertheless, balance training remains a pertinent intervention strategy when considering this patient's history of and probable risk of future falls. Exercise programs that include balance training and muscle strengthening have been found to be effective in reducing rate of and risk of falls.⁴³ Progressive balance training programs designed specifically for osteoporosis have been shown to be effective in reducing actual falls and improving dynamic balance in a 1-year follow-up period.⁴⁴ Balance training emphasizing dual-task training have also been shown to be effective in reducing fear of falls on the FES-I for patients with osteoporosis.⁴⁵ More novel interventions such as yoga, Tai Chi and the Otago program also show promising results for older adults with osteoporosis or balance deficits.^{42,46,47} These programs generally range from 12 weeks to 1 year in duration.

For this patient, moderate to advanced balance training utilizing the environment and the addition of cognitive tasks would be appropriate for her level. Specific exercises that would challenge her may include sitting on balance balls with cognitive and motor task additions, walking on soft foam forwards and backwards, or performing lunges on request.⁴⁸ In addition, implementation of multiple interventions appears to significantly reduce rate of falls in older adults, with some of the most effective being a combination of exercise, home safety intervention, and vision assessment.^{8,43} Given that this patient had abnormal scores on the Mini-BESTest,

HIMAT and FES-I, these tests would be the most appropriate to evaluate treatment effectiveness and reassess risk post-intervention in this case.

Cognitive Interventions

A PT's main role in screening for cognitive deficits is to convey such findings to the relevant healthcare professionals, in order to facilitate formal diagnosis. Although cognitive therapy is generally out of the scope of PT practice, it may be useful to have brief knowledge regarding the interventions targeting cognitive decline.

Of the current interventions available, only cognitive and behavioural programs consistently show efficacy in conferring benefits in MCI.^{49,50} Many of these programs tend to emphasize memory training and stimulation, which is congruent with the key clinical characteristic of MCI.⁵¹ Such programs are usually conducted by trained health professionals in outpatient memory clinics.

Combined Training

A combined approach incorporating both cognitive intervention and balance training demonstrates significant potential in reducing falls risk in older adults with MCI compared to balance training alone.^{52,53} Specifically, improvements were demonstrated in the TUG with dual task, Tinetti POMA, and the BESTest, but not the FES-I.^{52,53} Given the validity of the outcome measures used in this study, such a combined approach may prove promising for the patient in this case. More rigorous studies with valid and sensitive outcomes should be considered for future research to explore such novel interventions.

Prognosis

As previously discussed, it is difficult to conclusively quantify this patient's risk of future falls. However, interventions targeting osteoporosis and/or mild balance deficits demonstrate promising benefits that may be applied to this patient, including improved dynamic balance, reduced fall rate and reduced fear of falling.

Predicting and preventing falls in patients with osteoporosis is of particular interest because of the risk of osteoporotic fractures.¹³ Independent of falls, this patient's 10-year fracture risk using the FRAX ®WHO Fracture Risk Assessment Tool is calculated to be 1.7% for major osteoporotic fracture and 0% for hip fracture.⁵⁴ This provides some reassurance, but does not diminish the importance of preventing falls to minimize fracture risk.

Studies have shown that MCI cases have a conversion rate to dementia of about 6-16% per year.¹⁰ Early cognitive interventions appear to have some merit in arresting or delaying cognitive decline and progression to dementia.⁴⁹

Strengths and Limitations of the Case

This case has clearly demonstrated that many clinical tools used in the screening of balance and cognitive decline are not sensitive enough to detect mild levels of deficit despite demonstrating generally high specificity, sensitivity, and concurrent validity with one another in research trials. The performance of an assessment tool is meaningless without proper interpretation of the results; thus, this case has shown that achieving this can be challenging because it depends on whether the characteristics of the patient matches those of the persons investigated in the validation studies. Furthermore, in clinical application, a positive result on a test may be in reality a false positive. Conversely, a negative result may actually be a false negative. The decision on whether or not to refer or to treat the patient has to take into consideration the entire clinical picture and the individual's circumstances. For this case, the results also demonstrate that referral to a PT would not be deemed unnecessary given the positive findings of the balance and cognitive tests despite the absence of functional and participation limitations.

On the other hand, the ambiguity and challenge in interpreting test results also serves as a limitation in this case. A clinical tool's performance on a single individual is not indicative of its overall psychometric properties and hence should not be dismissed in its general clinical utility. This is a reminder to clinicians of the importance of carefully selecting the most appropriate and valid tools to measure the individual patient's outcomes using a battery of tests and measures where possible.

Considerations for Research

There are several areas of potential for future research. Firstly, the development and validation of sensitive instruments to detect mild balance deficits should be considered. Based on this case, the Mini-BESTest, HIMAT and FES-I prove the most promising. Validation of these and any new tools should be explored in participants while taking into consideration that health and disability are not strictly reflected by chronological age alone. This would pave the way for better falls-prediction algorithms and intervention plans to be developed. Secondly, the concept of poor reactive postures should be explored more thoroughly, given the reasonable association with accidents being the most prevalent reason for falls, and incorporated into both clinical outcome measurement and intervention approaches for mild balance deficits. Future research on developing clinical tests of postural responses to predict falls in individuals with mild balance deficits may warrant merit. Thirdly, the utility of the MMSE and the MoCA in combination should be further explored to develop an algorithmic approach to screening for MCI in the general population, having shown promise in this

case. Lastly, given the emerging recognition that falls and cognition are linked, combined balance and cognitive therapies should be explored further as a promising management approach to falls prevention.⁶

CONCLUSION

As concepts of ageing and health continue to change, so must research and application of clinical tools conform to properly address deficits in health and function. Early intervention to address mild balance and cognitive deficits require specific, sensitive clinical tools to detect and classify risk in pre-old adults. Of the currently available instruments, the Mini BESTest, HIMAT, FES-I, and the MoCA demonstrated the most potential in screening for mild deficits in this case study. More research on mild balance and cognitive deficits should be conducted in order to develop better clinical tools to detect impairment, risk classification, and guide optimal management approaches in this group of at-risk patients.

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